

INFLUENCE OF GAMMA RADIATION FOR CONTROLLING BREVIPALPUS PHOENICIS (ACARI: TENUIPALPIDAE) (GEIJSKES, 1939) IN OXYGEN ATMOSPHERE

André R. Machi¹, Valter Arthur²

¹ Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
rica_machi@hotmail.com

² Centro de Energia na Agricultura (CENA/USP - SP)
Av. Centenário 303
13416-000 Piracicaba, SP
Arthur@cena.usp.br

ABSTRACT

Brevipalpus phoenicis mite are controlled across of solutions acaricides, which are chemicals and leave residues in addition there is the difficulty of an effective pulverization due to the small size of the mite, the objective of this study was to evaluate of the influence of oxygen combined with gamma radiation on *B.phoenicis* as alternative control. Were used 70 mites per arena in 9 reps on 3 treatments at doses of 0 (control), 200 and 300 Gy. For irradiation, the leaves containing the mites, were cut and placed on bottles with bladder tied with ribbons and strings, before was put pure oxygen and the bottle was then sealed, these were taken to a gamma irradiator of Cobalt 60-type Gammacell 220, under a dose rate of 0.381 kGy/hour located in the CENA/USP. Was evaluated daily (eggs, nymphs and adults) of the mites observed viability, fertility and mortality across of the analysis of variance design with completely randomized design using the Statistical Analysis System (SAS) version 9.2[®] and by the Tukey test, the verification of means. After 22 days of irradiation the hatchability in 200 Gy dose was 41% after 3 days and 57% in control dose, this differed statistically of the other doses, where the nymphs arrived to the adult stage, which did not occurred in the 200 Gy dose and higher due to mutations, generated by the gamma radiation. In 300 Gy not was observed the presence of nymphs and eggs, being the sterilizing dose for all stages of the *B.phoenicis*.

Key words: citrus leprosis mite, Gamma radiation, oxygen

1. INTRODUCTION

In citrus *Brevipalpus phoenicis* Geijskes (1939) (Acari: Tenuipalpidae) is a major pest of citrus for being virus vector CiLV (Citrus leprosis virus) causes citrus leprosis, one of the most serious diseases of citrus in Brazil. The importance of leprosis in Brazil is due to its widespread occurrence and the serious losses that it causes and especially the difficulties in the management, [1].

The main method of control of the leprosis mite is by means of spraying with solutions acaricides, which are chemical and leave residues where are applied, moreover, there is the difficulty of spraying efficient due to the miniature size of the mite. Due to this inefficiency and of other methods, a large number of insects and mites may be loaded by fruits and vegetables during post-harvest manipulation. Many of these species of insects and mites can cause disturbances in the commercialization of these commodities between countries. Consequently, an effective treatment quarantine for the insect disinfestation, which is not prejudicial to the consumer, to the merchant and the product is essential to allow the distribution of fruits and vegetables [2].

The use of controlled atmosphere is the change in the composition of a gaseous environment [3] which together with irradiation techniques constitutes an alternative to the chemicals for the control of insects and mites [4,5].

The addition of oxygen can cause a cellular-level damage by reactive oxygen species (R.O.S.); also known as free radicals, the which is perhaps the most significant. R.O.S., such as the superoxide and hydroxyl ions, react with a wide variety of molecular species, causing considerable damage and interfering with cellular function [6]. ROS are also central to the oxidative damage hypothesis of ageing and play a role in numerous human diseases and too in eukaryotic organisms as insects [7].

[8,9,10] related that treatments with hypoxia combined with irradiation for phytosanitary treatments in insects and main in tephritid are highly developed and effectives.

The Which not the case for all species of insects and mites in which the work on the biology of mites using gamma radiation are scarce in this area, and being that the International Agency of Energy Atomic (IAEA) determined that doses accepted generic are of 400 Gy, what is considered a relatively high dose [11].

Studies with radiation are important mainly for of the families mites Eriophyidae, Tarsonemidae, Tenuipalpidae and Tetranychidae which are quarantine pests and phytosanitary treatments for post-harvest are often needed. The dose for these pests may be at least 350 Gy [12].

Thus, the use of radiation for disinfestations can be an alternative control in pests, the objective of work was to evaluate different doses of gamma radiation on *B.phoenicis* under the influence of oxygen.

2. MATERIALS AND METHODS

2.1. Collection of mites *B.phoenicis*

The mites were ceded and collected of a creating of two years located in the sector of Entomology and Acarology, laboratory acarology ESALQ / USP. The experiment was conducted in Piracicaba-SP, at the Center for Nuclear Energy in Agriculture (CENA / USP), in the laboratory of Radiobiology and Environmental where this rearing massal was maintained permanently.

2.2. Step of addition of oxygen

First, the arenas of massal rearing containing leaves female adult satge in different arenas, then were cut and placed on bottles, posteriorly the pure oxygen was added, and then a bladder was tied a string and then the bottle was sealed.

2.3. Irradiation of mites:

For irradiation the bottles, they were taken to a gamma irradiator of Cobalt- 60 Gammacell type 220 under a dose rate of 0.381 kGy / hour in the doses 0(control), 200 Gy and 300 Gy located in CENA / USP.

2.4. Evaluation of the experiment after Irradiation

The bottles with leaves containing mites now irradiated were placed in new arenas with leaves of *Canavalia ensiformis*.L. and distributed in their respective arenas, in three treatments, nine repetitions with 70 mites adults female. The each 24hs was evaluated at the counting of all stages (count of the different stages that will emerge) of *B.phoenicis* the parameters of viability, survival and mortality of the mites.

2.4. Statistical analysis

For observation data, were used analysis of variance with completely randomized design, with the Statistical Analysis System (SAS) version 9.2 ®. For verification of means, was used the Tukey test at 5% probability.

3. RESULTS

3.1.1. Number of eggs per adult female after irradiation on oxygen

During the 22 day period of experiment, was observed by the Tukey test ($p < 0.05$), that after the 22 days period, doses of gamma radiation applied in environmental hypoxic had an effect significant in the biology of the mites.

The number of eggs in irradiated mites, increased during the experiment in relation the control dose, the dose of 200 Gy presented difference significant between control dose and 300 Gy, this major oviposition too was observed in total numbers, 2644 for 200 Gy versus 1671 in control dose. The effect of the gamma radiation on oxygen in this dose induced these biggest numbers of eggs, but in the general, the oviposition of *B.phoenicis* decreased with the increased of the doses applied (Table1).

Table 1. Oviposition mean of adults irradiated on different levels of radiation

Treatment replicate	Gamma radiation	Oviposition	Total
	Doses (Gy)	Eggs \pm SD	Number eggs
T1	0	29.3 \pm 2.3 ^a	1.671
T2	200	46.3 \pm 4.8 ^b	2.644
T3	300	18.1 \pm 8.0 ^{ac}	214

* Means followed by the same letter do not differ by Tukey test at 5%

3.1.2. Number mean of survival on nymphs irradiated

The number of the nymphs after 22 days, decreased with increased of the doses applied, the number of nymphs in the irradiated doses was lower and differ of the control dose.

B.phoenicis had their population decrease at 200 Gy and higher more of 50%, this stage, was the most tolerant with regard to mortality, the nymphs that were irradiated in the two doses, already in the first day was possible observed in the (Table 2).

The effect of gamma radiation in the survival of nymphs, was more evidenced when there was the increased of the doses independently of the number of eggs laid as showed in the table 1. No was evaluate in this experiment the stage adult and se nymphs separated arrive stage adults.

Table 2. Number mean (\pm) SD of the nymphs irradiated of *B.phoenicis*

Dose (Gy)	Population (\pm)SD	Total nymphs
0	20.4 \pm 2.1 ^a	150
200	2.4 \pm 5.9 ^b	0
300	No nymphs	0

* Means followed by the same letter do not differ by Tukey test at 5%

3.1.3. Fertility x Sterilizing of eggs on female adults of *B.phoenicis*

The fertility of eggs emerged from irradiated adults, lost their capacity at dose 200 Gy and higher, where the percentage of hatchability was zero and differ of the control dose with more of 60 % of emergency (Table 3).

From of 7 days of the irradiation, the nymphs irradiated had a high mortality, the nymphs hatched of the females adult irradiated were sterile at 200 Gy dose and higher, being this stage of the mite more tolerant with regard to mortality in our studies.

Table 3. Percentage (%) of fertility x sterilizing on *B.phoenicis* nymphs after irradiation of the adult female

Dose (Gy)	3 days	7 days	14 days	22 days
0	57	69.4	71.57	75.60
200	41	35.5	3.59	0
300	No nymphs	No nymphs	No nymphs	No nymphs

4. DISCUSSION

During observations, the effects of gamma radiation, presented as negative for survival of immature stages until adults of the *B.phoenicis* mites. The mean number of eggs, showed that there was an increased in the laid eggs, that differ of the control dose, but this biggest quantity of eggs had an effect inverse in the proportion eggs x nymphs, due an high mortality of nymphs, many theses no arrived to the adult stage, resulting in few nymphs during the experiment.

In general there was a positive compartment between the increased dose and lower survival on stages of the mites. In eggs, exposed the gamma radiation, there was an increase of the oviposition in the 200 Gy dose, this fact, too was observed in other insects and mites by authors as [13,14,15,16]. According to [17] mites as *B.phoenicis* belonging to reproductive characteristic r-strategist, which makes these species, prioritize reproduction, as a way to generate a new offspring rather than of storing energy for its own survival.

From the seventh day, there was an accentuated reduction in the population of nymphs at 200 Gy dose reducing at zero after 22 days and differ of the control dose, no there was adults in irradiated doses.

According to [18] the study of gamma radiation effects on embryonic stage of *Tetranychus pierce* McGregor, showed that the hatchability decreased 99.0% after four-day.

Studies [19] in *Tetranychus urticae* Koch shown that the dose of 350 Gy induced a sterile eggs production mite, in our studies nymphs hatched at dose of 200 Gy and 300 Gy no arrived to the adult stage. The influence of addition oxygen in the moment of irradiation during the experiment can have contributed to lower survival. In *Grapholita molesta* Busck the effect of hypoxia on the survival of larvae irradiated inhibits the reproduction of these [20].

To [21] the effects of gamma radiation and sensitivity to oxygen in insects are most likely related to residual biological damage than the physical damage, because this factor may be related to the an organism ability to repair their own DNA.

What means that a lower dose of gamma radiation applied in hypoxic environments are as devastating as a higher dose applied without such environment, because insect or mites resistance to radiation becomes low when it is exposed to little oxygen.

Our results indicated a sterility dose of 300 Gy to all stages of *B. phoenicis*, others authors as [22] too obtained 300 Gy as sterilizing dose in *Oligonychus biharensis* Hirst mites of family tetranychidae.

Too [23] irradiated *T. urticae* adults, and 300 Gy was sterilizing dose to this mite. But other researchers reported different doses for the sterility, which ranged from 80 to 400Gy, this result can be important to determine doses lowest to phytosanitary treatment, already that currently are accepted generic doses of 400 Gy, what is considered a relatively high dose.

5. CONCLUSION

Our results showed that 300 Gy, can be the sterilizing dose for prevent reproduction and development of futures generations of *B. phoenicis* mite in agricultural commodites.

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