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APPLICATION OF GAMMA RADIATION ON LONGEVITY OF SOME MITES SPECIES (ACARI: TETRANYCHIDADE)

Andre R. Machi[1], Valter Arthur[2]

[1] Controle de Tecnologia das Radiações (CTR)
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 Nuclear na Agricultura
Av. Centenário 303
13420-504 Piracicaba, SP
arthur@cena.usp.br

ABSTRACT

Mites are pests agricultural found in various environments accessible to animal life: soil, aerial parts of the plants, host insects. In this research the effects of gamma irradiation on longevity of mite pests of the tetranychidae family have been studied. The mites were irradiated in a source of Cobalt-60, Gammacell-220 type, at a dose rate of 0.486 kGy located in the CENA/USP, in the doses of 0 (control), 100, 200, 300, and 400 Gy with sixteen replicates per dose. After the irradiation, the mites were placed in petri dishes totalizing 5 treatments in 32 repetitions. The analysis of variance design with completely randomized design using the Statistical Analysis System (SAS) and the Tukey test, the verification of means. Were evaluated daily the adult mortality and longevity of irradiated mites. After 25 days was observed a mean longevity of mites, for *O.ilicis*, 100 Gy was equal the control dose (18.3 days), but to *T. desertorum* and *T. urticae* the larger longevity was observed in the dose of 200 Gy (19.0 days) being that this dose, obtained the larger longevity in comparison to control dose (18.5 days), in general the longevity decreased in relation to increased doses. Thus, only the dose of 100 Gy and 200 Gy stimulated an increased the longevity in *O. ilicis* and *T. desertorum* and *T. urticae* respectively. The exact mechanism by which the mites are tolerant to avoid damage caused by radicals when exposed to ionizing radiation is not fully understood.

1. INTRODUCTION

Mites pests as *Tetranychus urticae*, *Tetranychus desertorum* and *Oligonichus ilicis* and others, usually attack almost every type of crops in the Brazil, such as: Mango, Strawberry, Citrus, Lychee, Cucumber, Eggplant, among others. The study on irradiation of mites is justified by the fact that it comprises a large number of arthropods that cause losses of millions of dollars every year with the use of acaricides for phytosanitary pest control [1].

Mites can cause impacts direct (i.e. quantitative and qualitative losses) and indirect (i.e. low values for agricultural products in the world market commodities). [2], observed estimated losses worth billions of dollars to crops and pastures in several countries due to mites.

The distribution of these losses is variable, because the socioeconomic differences of the country and the available scientific information and techniques to estimate the potential economic impact of these pests is limited [3], with reports existing for only a few species [4].

Among the used treatments are the chemical methods, however the methyl bromide is a substance which destroys the Ozone layer and it is being already removed of the market [5].

Due to those problems, alternative methods of control as the quarantine treatment with gamma radiation have been used in the control of pests of plants, as with foods where this alternative method is already used with success.

This method also is used with success for the control of insects by authors as [6-9]. But when it comes to mites of agricultural importance there are few studies in the area of irradiation and lower with longevity of mites.

There are a number of investigations on this group of pests and they show that the mites appear to be as tolerant as the most tolerant insects [10-16].

The doses which cause immediate mortality in mites (1–3 kGy) could also seriously damage the plants generating phytotoxicity effects and hence may not be used as a quarantine treatment [17].

If, on the other hand, lower doses could be found which are in the tolerance range of products and prevent reproduction of new generations, it can be proposed as a quarantine treatment. In this research the effects of gamma irradiation on longevity of mite pests of the tetranychidae family have been studied.

2. MATERIAL AND METHODS

The research was performed in the Laboratory of Environment and Radiobiology, Center of Nuclear Energy in Agriculture (CENA/USP), at the University of São Paulo, Piracicaba - SP. The experiment was accomplished in two stages.

In the first stage tests to determine minimum and maximum doses and observation of radio-resistance of mites were made. In the second stage we evaluated the effects of these doses in irradiated and non-irradiated organisms with ionizing radiation.

The mites used in this experiment were obtained from a mass rearing maintained in the laboratory for more than three years, assigned by the Department of Acarology, School of Agriculture "Luiz de Queiroz" (ESALQ / USP), Piracicaba-SP and Biological Institute Campinas (IB), Campinas-SP.

Bean plants infested with mites take from rearing mass for obtaining pregnant adult female. Thereafter, each species of mites has been identified in a stereomicroscope and transferred with a fine tip brush for one female mite were placed in petri dishes (a total of 32 plates) containing jack bean leaves (*C. ensiformis* L) except for *O. ilicis* where these tests were conducted on coffee leaves (*C. arabica* L).

For irradiation of these petri dishes containing mites females adults, we used an irradiator of Cobalt-60, Gammacell-220 type with a dose rate 0.486 kGy / hour located in Center of Nuclear energy in the Agriculture (CENA/USP), in Piracicaba-SP.

Each species of mite was irradiated at doses of 0 (control), 100, 200, 300 and 400 Gy, with a total of 5 treatments and 32 replications per treatment, each female mite was counting as one repetition.

After irradiation, the petri dishes were placed in plastic boxes for each treatment and then placed in a climatic chamber with a temperature of 25 ± 5 ° C and relative humidity of 70 ± 5%. Later the evaluations were accomplished every 24 hours, for a period of 25 days after irradiation, were evaluated daily the adult mortality and longevity of irradiated mites.

3. RESULTS AND DISCUSSION

The analysis of variance in the adult female longevity after irradiation showed that applied of the dose had a significant effect ($p < 0.001$) on the survival percent of the longevity in adult females.

The mean longevity of irradiated females decreased with increasing of the dose, the longevity of all irradiated mites in the general when compared with the control was lower in all treatments, except to 100 Gy in *T.urticae* (18% and 19% in mean for 26 days, compared to control 17% and 18%).

For *T.desertorum* in the dose of 100 and 200 Gy the survival percent were (15% and 17 % for 27 and 28 days respectively). In comparison to control (16% and 28 days) both the doses not showed statistically differ.

For the *O.ilicis* mites, in the control (15% for 25 days) and 100 Gy (13% in 25 days) The 200 Gy (9% in 25 days) was stastitically differ in comparison to control.

In general in this study was observed a decreased of survival percent longevity for the three mites in all doses from 100 Gy. The mites *O.ilicis* were the that showed the lower longevity and *T.urticae* the larger. The gamma radiation effects was larger in the doses of 300 and 400 Gy in all mites, and the longevity was larger only in the dose of 100 Gy for *T.urticae* in comparison to the control (Figure 1, 2, 3).

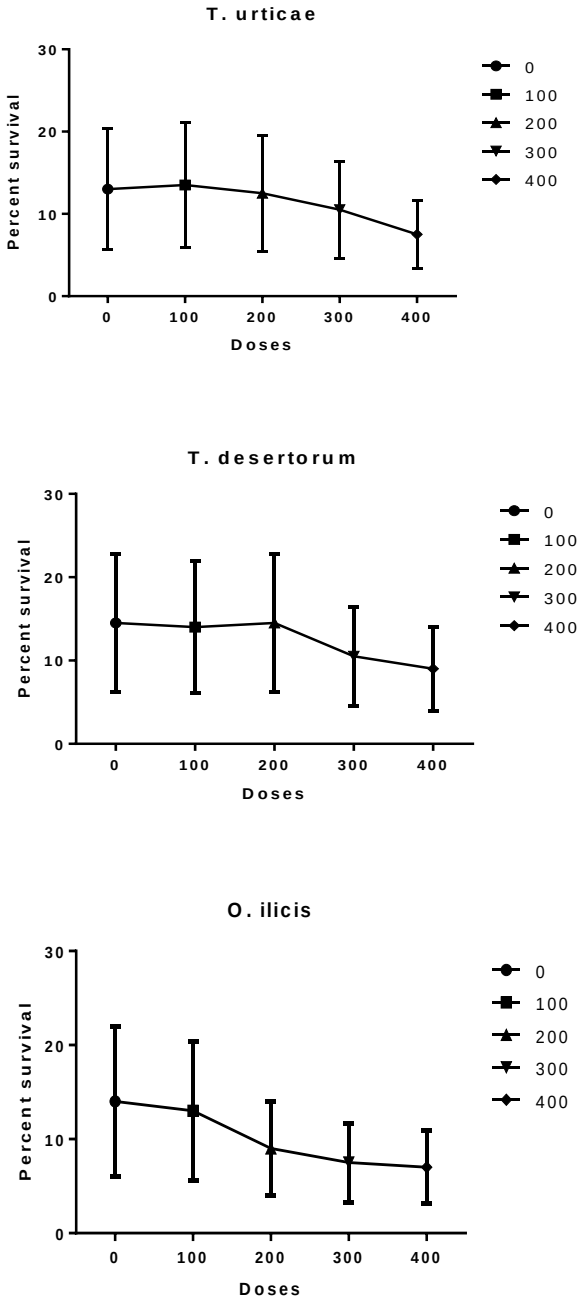

Figure 1,2,3: Effects of gamma radiation on mean longevity of the mites

The gamma radiation effects were observed in an one of the first researchs in the area observed that brief exposures to high temperatures in irradiated females of *Drosophila subobscura* increased longevity and caused significant damage to the ovaries, the authors suggested that the decrease in egg laying would be the reason for increased female longevity so he could save their protein and energy reserves to the somatic tissues. [18].

[19] also affirmed that the irradiation can lead to increased resistance to insects (eg, adult Diptera) due to a lack of renovation of somatic cells that are old and thus promoting larger longevity in insects.
Following these studies [20] showed some suggestions on longevity in irradiated insects.
1. irradiated insects should present higher resistance to environmental stresses, particularly in post-mitotic periods in which the resistance of insects decreases with age.
2. DNA damaging factors when used in adult insects (e.g., UV, chemical) must also produce an increase in the longevity and resistance to stress.

3. Irradiation can also result in longevity increases, radiation resistance, or resistance to stress in other organisms that has no renewal somatic cells.

According to [21] this increase of life can occur in various orders, sexes and families. These physiological aspects in insects have been widely studied [22]. However, the exact mechanism by which developmental stages of insects are tolerant to avoid damage caused by radicals when exposed to ionizing radiation is not fully understood [23]

These factors presume that the longevity of irradiated mites in general to *T. urticae*, *T. deserto rum* and *O.ilicis,* are still unknown and need further studies to be better elucidated, but this larger longevity of mites in our experiment was decreased with the increase of the doses applied, however doses of 100 and 200 Gy were similar to the control in longevity when 300 and 400 Gy were doses that showed lower longevity in all mites, this factor can be used for more control effective of pests of the integrated pest management for quarantine treatments.

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