

Effect of gamma radiation against the Mediterranean fruit fly *Ceratitis capitata* (Diptera:Tephritidae) in guava fruits

H. O. S DÓRIA, N. M. M. S. ALBERGARIA, V. ARTHUR, S. A. DE BORTOLI

Fruit flies of the family Tephritidae are considered the most important insects pest risk carried by exported fruits worldwide. Because reports have show that guavas are important host of the pest, quarantine treatments must be developed if it's to exported to countries which impose quarantine restrictions on Mediterranean fruit fly infestable commodities. Ionizing radiation is one alternative method of quarantine treatment. This work was carried out to study the effect of different doses of gamma radiation against eggs and larvae of *Ceratitis capitata* in guavas of "Pedro Sato" cultivar. Guavas artificially infested with eggs and larvae were exposed to ionizing gamma radiation at the following doses: 0 (control), 50, 100 and 150 Gy for eggs and 0 (control), 50, 100, 150, 200 and 250 Gy for first and third instar larvae, at the dose rate of 352 Gy per hour. After irradiation fruits were put in plastic pots in a room at $25\pm 1^\circ\text{C}$ and $70\pm 5\%$ RH. Pupae obtained were sieved out and kept in small glass tubes. All doses tested did not allow emergence of adults in both treatments (eggs and larvae).

H. O. S. DÓRIA. PG Student, Universidade de São Paulo, Department of Entomology, Av. Bandeirantes, 3900, 14040-901, Ribeirão Preto-SP, Brazil. hosd75@terra.com.br

N. M. M. ALBERGARIA. PG Student, Universidade Estadual Paulista, Department of Entomology, Via de Acesso Prof. Paulo Donato Castellane, s/n, 14884-900, Jaboticabal-SP, Brazil. nmendes@terra.com.br

V. ARTHUR. Professor, Centro de Energia Nuclear, Department of Radioentomology, Av. Centenário, 13400-970, Piracicaba-SP, Brazil. arthur@cena.usp.br

S. A. DE BORTOLI. Professor, Universidade Estadual Paulista, Department of Entomology, Via de Acesso Prof. Paulo Donato Castellane, s/n, 14884-900, Jaboticabal-SP, Brazil. bortoli@fcav.unesp.br

Key words: Quarantine treatment, irradiation, fruit fly, *Psidium guajava*.

INTRODUCTION

Guava, *Psidium guajava* L., is a host for many Tephritidae fruit fly species, including, *Anastrepha fraterculus*, *A. obliqua* and *Ceratitis capitata*, consequently, Brazilian guavas are excluded from potential markets outside. Fruit flies of the family Tephritidae are considered the most important insects pest risk carried by exported fruits. Fruits suspected of harboring fruit fly eggs and larvae must be treated to control virtually 100% of any tephritids present. The goal of plant quarantine in

this context is to prevent the fruit fly species from establishing in an area which it does not occur.

Alternative quarantine treatments for fresh fruits are needed because fumigants are being lost due health and environmental problems. These alternatives should be more environmentally friendly and less harmful to users and consumers. Ionizing radiation is one quarantine treatment alternative method and has provided an acceptable quarantine treatment for grapefruits and mangoes infested with fruit fly eggs and larvae. Ionizing

radiation has distinct advantages as a quarantine treatment, such as application to products that are already packed, low damage incidence to many agricultural commodities, don't let residue, and speed of treatment.

Considering these facts, this work was carried out to study the effect of different gamma radiation doses against eggs and larvae of *C. capitata* in guavas 'Pedro Sato' variety.

MATERIAL AND METHODS

The experiments were done in the Laboratory of Biology and Rearing Insects at FACV/UNESP, Jaboticabal, São Paulo, Brazil. For carried out this trial, *C. capitata* pupae were brought from the Radioentomology Laboratory of CENA, USP, Piracicaba, São Paulo, Brazil. About 15000 pupae were placed in a cage (1.0 X 0.5 X 0.5m) for adult emergence. Four days after emergence, it was observed that females were laying eggs, then 'Pedro Sato' guavas (mature-green stage) collected in Val Popas' Farm, Vista Alegre do Alto, SP, Brazil, after selection and standardization, were placed into the cage for 48 hours to obtain infestation with eggs. After that, the fruits were removed from the cage randomized and divided in 4 lots. One lot randomly selected from the total (120 fruits) and held as untreated control was used to determine the infestation level (number of larval surviving in the fruit). Since the number of insects cannot be measured directly, this value was estimated from the number recovered in the untreated (control) lot. The others lots were exposed to ionizing gamma radiation at the following doses: 50, 100 and 150 Gy.

A group of 360 fruits were separated to develop the tests with larvae. In this experiments 180 fruits were artificially infested with 20 *C. capitata* young larvae (1st and 2nd instars) and 180 fruits with 20 old larvae (3rd instar). To develop these trials, the fruits were perforate and the larvae were placed inside each fruit, after that the fruits were covered and exposed to ionizing gamma

radiation at the following doses: 50, 100, 150, 200 and 250 Gy. One lot of untreated fruits was held as control. Irradiations were performed at CENA/USP, Piracicaba, São Paulo, Brazil, in a Gammabeam-650 irradiator, containing Cobalt⁶⁰, at the dose rate of 352 Gy per hour.

Untreated and treated fruits were placed individually in pots with vermiculite in a room at $25 \pm 1^\circ\text{C}$ and $75 \pm 10\%$ RH. It was used 30 replications for each dose. The treatment efficiency was evaluated 15 days after, by the number of pupae recovered from each treatment which were held under optimum conditions (in moist vermiculite at 25°C) for adult emergence.

RESULTS AND DISCUSSION

Evaluation of the efficacy of a treatment involving ionizing radiation is based on prevention of adult emergence (OHTA *et al.*, 1985, ARTHUR, 1998, COSTA & ARTHUR, 2002). This differs from heat, cold or fumigation because these treatments generally kill the stage of the insect treated in situ and efficacy of the treatment is based on prevention of larval pupation (BAKER, 1939). With irradiation, some mortality will occur at the stage treated but many larvae will crawl out and pupate; therefore, the actual efficacy of the treatment must be based on adult emergence.

Mortality of immatures was calculated from actual recovery pupae formed compared to the number projected to have been present, based on the control population. We could observe that egg mortality increased with the dose, but for young (1st and 2nd) and old larvae (3rd) the mortality was variable (Table 1). BUSTOS *et al.* (1992) irradiated $\approx 100\ 000$ Mexican fruit fly third instar in mangoes, *Mangifera indica* L., to 100 Gy and obtained no adult emergence, while adult emergence in the unirradiated control was 84%.

Table 2 presents the gamma radiation exposure required to prevent pupation. Dosages required to prevent 50% (LD₅₀) of

Table 1. Effects of ionizing radiation on mortality of immature stages of Mediterranean fruit flies in guavas.

Dose (Gy)	N° Insects Treated			Insects Killed			% Mortality		
	Eggs	L ₁₋₂	L ₃	Eggs	L ₁₋₂	L ₃	Eggs	L ₁₋₂	L ₃
50	2580	600	600	2010	270	330	78,3	44,8	53,2
100	2580	600	600	2250	180	360	87,3	28,2	60,5
150	2580	600	600	2370	420	480	92,4	70,2	79,2
200	-	600	600	-	330	390	-	55,2	64,2
250	-	600	600	-	420	450	-	71,5	75,5

Table 2. Gamma radiation required to prevent pupation of different fruit fly stages treated in guava fruits.

Stages	LD ₅₀	LD ₉₀	X ²
Egg	12.8	425.5	0.0165
L1-L2	33.5	1643	1.2897
L3	103.2	1862	5.5426

pupation for eggs, young (1st and 2nd) and old larvae (3rd) were, 12.8, 33.5 and 103.5 Gy, respectively. The LD₉₀ obtained for both larval stage were very high.

Studies on irradiation of mixed age larvae of *Anastrepha suspensa* (Loew) in grapefruit made by BURDITT *et al.* (1981) showed that although 300 Gy was required to prevent pupation, 100 Gy prevented emergence of adults. In our study the doses tested didn't prevent the total pupation but since 50 Gy there wasn't adult emergence. The irradiation action mode for quarantine against fruit flies is unique when compared with traditio-

nal chemical treatments. Quarantine security can be achieved even though live larvae capable of pupation may be present in the fruit after treatment. In this first work Probit 9 analysis could not be done because the variation in the data didn't fit the model. However the data reported here show that doses higher than 250 Gy are required to prevent larvae pupation. In further studies it's necessary to test doses below 50 GY and above 250Gy, to get more data to develop Probit 9 analysis. No damage occurred in 'Pedro Sato' guavas at the levels of irradiation between 50 and 250 Gy.

RESUMEN

DÓRIA H. O. S., N. M. M. ALBERGARIA, V. ARTHUR, S. A. DE BORTOLI. 2007. El efecto de la radiación gamma contra la mosca de fruta del mediterráneo *Ceratitis capitata* (Diptera:Tephritidae) en las frutas de guayaba. *Bol. Veg. Plagas*, 33: 285-288.

Las moscas de la fruta de la familia Tephritidae son consideradas el riesgo de plaga de insectos más importante llevado por fruta exportada por todo el mundo. Debido a que los informes demuestran que las guayabas son huéspedes importantes de la plaga, los tratamientos de cuarentena deben desarrollarse si van a exportarse a países que imponen las restricciones de cuarentena ante materias infestables de la mosca de fruta mediterránea. La radiación de ionización es un método alternativo de tratamiento de cuarentena. Este trabajo fue realizado para estudiar el efecto de diversas dosis de la radiación gamma contra los huevos y las larvas de *Ceratitis capitata* en guayabas de la variedad "Pedro Sato". Las guayabas artificialmente infestadas con huevos y larvas fueron expuestas a la ionización radiación gamma en las dosis siguientes : 0 (control), 50, 100 y 150 Gy para los huevos y 0 (control), 50, 100, 150, 200 y 250 Gy para larvas de primer y tercer instar, a dosis de 352 Gy por hora. Después de la irradiación las frutas se pusieron en pots plásti-

co en una cámara a $25\pm 1^\circ\text{C}$ y $70\pm 5\%$ RH. Las crisálidas obtenidas se tamizaron y mantuvieron en pequeños tubos de cristal. Ninguna de las dosis ensayadas permitió la emergencia de adultos en ambos tratamientos (los huevos y larvas).

Palabras clave: Tratamiento de cuarentena, irradiación, mosca de fruta, *Psidium guajava*.

RESUMO

DÓRIA H. O. S., N. M. M. ALBERGARIA, V. ARTHUR, S. A. DE BORTOLI. 2007. Efeito da radiação gama contra a mosca-das-frutas do mediterrâneo *Ceratitis capitata* (Diptera: Tephritidae) em frutas de goiaba. *Bol. Veg. Plagas*, 33: 285-288.

Moscas-das-frutas da família Tephritidae são consideradas os insetos mais importantes peste de risco levados por frutas exportadas mundialmente. Muitos trabalhos têm mostrado que as goiabas são importantes hospedeiros dessa peste, e tratamentos quarentenários devem ser desenvolvidos para que os frutos possam ser exportados a países que impõem restrições de quarentenárias para frutos infestados com mosca-das-frutas. A radiação ionizante é um método alternativo de tratamento quarentenário. Este trabalho teve como objetivo estudar o efeito de diferentes doses de radiação de gama contra ovos e larvas de *C. capitata* em goiabas do cultivar "Pedro Sato". Foram expostas goiabas artificialmente infestadas com ovos e larvas a radiação ionizante de uma fonte de Cobalto-60, nas seguintes doses: 0 (controle), 50, 100 e 150 Gy para ovos e 0 (controle), 50, 100, 150, 200 e 250 Gy para larvas de primeiro e terceiro de instar, à uma taxa de dose de 352 Gy por hora. Após irradiação as frutas foram colocadas em potes de plástico em uma câmara climática a $25\pm 1^\circ\text{C}$ e $70\pm 5\%$ RH. As pupas obtidas foram peneiradas e colocadas em pequenos tubos de vidro onde aguardou-se a emergência dos adultos. Todas as doses testadas não permitiram aparecimento de adultos em ambos os tratamentos (ovos e larvas).

Palavras chave: Tratamento quarentenário, irradiação, moscas das frutas, *Psidium guajava*.

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