

GAMMA IRRADIATION AND REARING DIETS EFFECTS ON LARVAL GROWTH RATE, THE DEVELOPMENT AND THE REPRODUCTION OF *Lasioderma serricorne* F

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ABSTRACT

The effect of different diets (Wheat flour, garlic , aniseed and Cumin) and gamma irradiation on the larval growth rate, the development and the reproduction of *L. serricorne* (F) were investigated. Newly hatched Larvae were irradiated by dosages 20, 40 and 60 Gy. There was variation of weight gain, feeding period and growth rate of Larvae according to the effect of type of food and the dosage of gamma ray. When larvae were fed on aniseed , the highest growth rate was recorded. There is an inverse relationship between, the larval growth rate and doses of gamma irradiation. Also the feeding period increased as the dose increased form 0 – 60 Gy in all types of diets.

Larval irradiation as newly hatched induced a reduction in percent pupation and adult emergence progressively as the dose was increased. The reduction reached maximum , when larvae were fed on garlic, while reached its minimum on aniseed. Fecundity , Fertility and longevity of the resulling adults were gradually reduced with the increase of the dose.

INTRODUCTION

The cigarette beetle, *Lasioderma serricorne* (F) is considered one of the main pests of stored products and Kinds of medical and aromatical dried plants (El- Halfawy 1977a, b).

Irradiation techniques seem to offere solutions that are desirables in many aspects. Pests that occur in stored products can be control by gamma radiation. Cornwell *et al.*(1966) and Tilton *et al.*(1971) suggested that by sterilization a resistance population some measure of protection against reinfestation by the same species could be obtained. Stored products also offer some unique advantages for effective utilization of the radiation technique the most important is that much lower doses are required for insect disinfestations than for most other food irradiation application., little attempts have been made to elucidate the effect of kind of hosts on there growth rates. Misra (1981) reported that insect pests associated with stored grains do not feed, breed, develop equally well on all the grains and these is always certain amount of host preference. However, attempts have been made to use gamma radiation to minimize the losses caused by the pest Abel Baki (1990 and 1996) and Tasan *et al.*(2002).

The present work deals with measuring the growth rate, the development and the reproduction of *L. serricorne* (F) treated with gamma irradiation and some different kinds of food as Larval diets.

MATERIALS AND METHODS

The stock culture of the cigarette beetle, *Lasioderma serricorn F.* were reared in the laboratory with a constant temperature of (32 ±1 c°) and relative humidity of (65 ± 5%).

Test insects were reared for several generations on powdered garlic, aniseed, cumin and wheat flour. Diets were sterilized in an oven at 60 c° for 6 hours before used.

To study the effect of radiation on Larval growth rate. Deposited eggs were daily collected and kept under the above mentioned conditions to obtain test larvae. 50 Larvae were irradiated and transferred to gars each containing sufficient amount of the diet. Dosages of 0.0, 20 , 40 and 60 Gy were used. Three replicates were done for each Treatment.

The Larvae were kept under controlled conditions. Newly hatched larvae of untreated control were incubated under the same conditions.

The growth rate of the untreated and treated larvae on different rearing diets was calculated according to Waldbauer (1968) as follows:

$$G.R = \frac{Wg}{DXA}$$

Where

G. R = Growth rate

Wg= weight gain

D = Duration of feeding period

A = Initial weight of insect + final weight of insect + 2

To study the effect of Larval gamma irradiated and rearing diets on the development . Newly hatched Larvae were irradiated with 0.0 , 20 , 40 and 60 Gray and were left on a constant amount of each diet in glass jars to estimate the rate of pupation and adult emergence. Each treatment was represented by 50 Larvae and replicated three times.

Immediately after adult emergence male and female combinations were paired as follows (1) irradiated male (I♂) X unirradiated (U♀ , (2) U♂ X i♀ Ten pairs of beetles for each treatment were replicated 4 times . Adult fecundity, fertility and longevity were recorded on aniseed only.

RESULTS AND DISCUSSION

Data recorded in Table (1) showed that the Larval weight fluctuated according to the used rearing diet, the highest weight gain (0.0154 mg) was observed when Larvae fed on aniseed and the lowest weight gain (0.0023 mg) when Larvae were fed on garlic. Data obtained also indicated that the mean weight of Larvae decreased as the dose of gamma radiation was increased. The highest decrease resulted at 60 Gy when Larvae were fed on garlic, the average weight gain / Larvae was 0.0009 mg as compared to 0.0023 mg for the control. However, the Larval feeding period was affected by diets, as it was 26.8 days on cumin and was prolonged to 35. Days on garlic.

Irradiation of newly hatched Larvae affected the larval feeding period which greatly increased as the dose increased for all kinds of food. For example at 60 Gy, it reached to 42.5 , 45.4 , 33.7 and 35.3 days on wheat flour, garlic, aniseed and cumin, respectively as compared to 33.3, 35.0 , 27.0 and 26.8 days in the control groups, respectively.

The results, that gamma irradiation may prolonge larval duration, are explained by many authors such as Soo-Hoo and Fraenkel (1966) ; Thornburn (1972), Russel *et al.*(1980) and Abdel – Mageed *et al.*(1986), who referred to factors governing digestion and utilization of food.

The result in Table (1) clearly demonstrate that the growth rate of stored product larvae is markedly affected by the kind of food. The data indicate that , the garlic was less valuable food for *L. serricornis*, as they have lower growth rates under those types of food. On the contrary, the aniseed was preferred to the cigarette beetle as was indicated by the higher growth rates. The data in Table (1) indicate that there is an opposite relationship between the growth rate of the larvae and dosages of gamma. The increase of dose from 0.0-6.0 Gy caused a decrease of the growth rate in all rearing diets. Similar response was reported with Hasaballa and Abdel Baki (1990) Abdel-Kawy and EL-Naggar (1992), Ramadan and Abdel Baki (1994) , Abdel-Kawy (1997), and Ahmed and Hassan (2001).

The rates of pupation and adult emergence of *L. serricornis* irradiated as newly hatched Larvae and reared on wheat flour, garlic, aniseed and cumin are given in Table (2). the lowest percentage of emergence (71.7%) was recorded when larvae were bred on garlic followed by cumin (73.3%) and wheat flour (80.0%). The highest percentage (86.0%) was recorded in case of aniseed.

In general, a gradual decrease in percent pupation and emergence occurred with increasing the radiation dosage at all used diets. These findings are in agreement with those Abdel Baki (1990), Hassaballa and Abdel Kawy (1992), Abdel Baki (1996 a , b), Aldryin and Adam (1999), Hassan *et al.*(2002) and Tsan *et al.*(2002) .

Data in Table (3) show that irradiation of Larvae affected egg viability of the produced adults of cigarette beetle , when irradiated females were crossed with unirradiated males. For example when newly hatched larvae were irradiated at 60 Gy, the number of deposited eggs per female was 32.8 eggs in (I ♂ X U ♀) compared with 24.8 eggs in (U ♂ X I ♀) and 58 eggs per female in the untreated check. Adult fertility was also adversely affected as a result of larval irradiation. The females were more affected than males when irradiated as newly hatched larvae. The longevity of adults seemed to be affected by all doses used. Adult longevity males and females irradiated as newly hatched larvae with 60 Gy dropped to 6.3 and 4.0 days respectively compared to 9.3 and 6.8 days respectively in untreated (control). Similar results were obtained by many authors such as Abdel Rahman *et al.*(1987). Thorayia *et al.*(1995) , Abdel Baki (1996 a , b) , Boshra and Ahmed (1996) . Samira *et al.*(2001) and El-Orabi *et al.* (2007).

Table (1): Effect of gamma irradiation and rearing diet on Larval weight gain, feeding period and growth rate of *L. serricorn* treated as newly hatched larvae.

Diets Doses Gray (GY)	Weight gain / larva (mg)				Feeding period (days)				Growth Rate				% reduction G.R			
	Wf	Ga	An	Cu	Wf	Ga	An	Cu	Wf	Ga	An	Cu	Wf	Ga	An	Cu
Control	0.0150	0.0023	0.0154	0.0098	33.3	35.0	27.0	26.8	0.0736	0.0513	0.0787	0.0573
20	0.0122	0.0019	0.0126	0.0080	34.3	36.7	27.8	27.6	0.0603	0.0431	0.0647	0.0468	18.07	15.98	17.79	18.32
40	0.0083	0.0013	0.0086	0.0066	39.7	41.3	31.9	32.0	0.0409	0.0286	0.0552	0.0389	44.43	44.25	29.86	32.11
60	0.0050	0.0009	0.0059	0.0045	42.5	45.4	33.7	35.3	0.0280	0.0196	0.0384	0.0266	61.96	61.79	51.21	53.58

Wf = Wheat flour Ga = Garlic An = Aniseed Cu = Cumin

Table (2): Effect of gamma irradiation and rearing diet on the rate of pupation and adult emergence of *L. serricorn* treated as newly hatched larvae.

Diets Doses Gray (Gy)	% Larvae reached to pupae				% Reduction in pupation				% Larvae reached to adults				% Reduction in adult emergence			
	Wf	Ga	An	Cu	Wf	Ga	An	Cu	Wf	Ga	An	Cu	Wf	Ga	An	Cu
Control	81.7	70.0	88.3	75.7	-	-	-	-	80.0	71.7	86.0	73.3	-	-	-	-
20	60.3	49.3	68.7	57.0	26.19	29.57	22.19	24.70	52.7	45.0	64.3	50.3	34.13	37.24	25.23	31.38
40	41.0	33.7	49.0	40.3	49.82	51.86	44.51	46.76	39.3	30.3	55.7	43.0	50.88	57.74	35.23	41.34
60	30.7	24.0	39.3	32.7	62.42	65.71	55.49	56.80	13.0	10.0	25.0	15.7	83.75	86.05	70.93	78.58

Wf = Wheat flour Ga = Garlic An = Aniseed Cu = Cumin

Table (3): Effect of gamma irradiation of newly hatched larvae on reproduction of the emerged adults of *L. serricorne*.

Dose Gray (Gy)	Mean No of eggs female	% Reduction in egg production	% Mean egg hatch	% Reduction in egg hatch	Longevity (days)	
Irradiated males X normal females (♂ X U ♀)						
Control	60.7	-	86.3	-	9.3	7.2
20	51.0	15.9	50.8	41.1	8.5	8.0
40	39.2	35.4	42.3	50.9	7.8	7.3
60	32.8	45.9	35.3	59.1	6.3	6.9
Normal males X Irradiated females (U ♀ X I ♂)						
Control	58.0	-	86.3	-	9.0	6.8
20	41.5	28.4	50.7	41.3	8.3	5.5
40	29.3	49.5	36.3	57.9	8.0	4.7
60	24.8	57.2	22.7	73.7	9.2	4.0

Aniseed only was used as a rearing diet

REFERENCES

- Abdel – Baki, S.M. (1990). Biological behavior of the cigarette beetle *Lasioderma serricorne* (F) , emerging from gamma irradiated larval or pupal stages. Bull. Entomol. Soc. Egypt. Econ. Ser. , 18:163 – 170.
- Abdel – Baki, S. M. (1996)a. Effects of gamma irradiation and certain rearing diets on some biological parameters of the cigarette beetle. *Lasioderma serricorn* (F) (Coleoptera : Anobidae). Arab. J. Nuclear sciences and Applications, 29 (3) : 261 – 270
- Abdel – Baki, S.M. (1996)b: Biotic potential and total proteins of gamma irradiated larvae of Khapra beetle *Trogoderma granarium* Everts. J. Agric. Sci, Mansoura Univ., 21 (10) : 3645 –3650
- Abdel – Kawy , F. K. (1997). Effect of gamma irradiation on the consumption and utilization of food by the Larval stage of the khabra beetle *Trogoderma granarium* Everts . Bull . Ent. Soc., Egypt, Econ. Ser., 24 : 81 – 88
- Abdel – Kawy, F. K. and El Naggar, S. E. M. (1992). Effect of gamma irradiation on the consumption, digestion and utilization of food in Larvae of *Sesamia cretica* (LED). Bull. Ent. Soc Egypt, Econ., Ser., 19: 203 – 209
- Abdel – Mageed, M. I. ; M.A EL- Banby; A. K . Sobeiha and S. M . Abdel Baki (1986). The effect of gamma irradiation on *Ephestia Kuehniella* (Zell) ATP – ase activity. (Bull , Ent. Soc . Egypt, Econ. Ser. , . 16 : 151 – 156)
- Abdel – Rahman, A.M. ; A. E. Aboul – Nasr; M.Y.Y. Ahmed and Z.A. Ahmed (1987). Gamma – irradiation effects on the larval stage of the long headed flour beetle, *Lathaticus oryzae* L. Bull. Ent. Soc. Egypt, Econ. Ser., 16
- Ahmed,Z.A. and Hassan, N.M.M.(2001). Effect of four rearing diets and gamma irradiation on Larval growth rate and the development of the confused. Flour beetle *Tribolium confusum* (DUV)Arab J. of Nuclear Science and Applications, 34 (2): 315 – 322.
- Aldryhin, Y. N. and Adam, E.F. (1999). Efficacy of gamma irradiation against *Sitophilus granaries* (L) J. of Stored Products Res., 35:3 225 – 232

- Boshra, S. and Z.A. Ahmed (1996): Irradiation of the rice moth larvae, *Corcyra cephalonica* (Staint) (Lepidoptera – pyralidae) Effects on development, sterility and Larvae Midgut. Arab. J. Nual. Sci & Appl., 29 (2): 79 – 89
- Cornwell, P.B.; J. O. Bull and P.B Pendlebury (1966). control of weevil population *Sitophilus granarius* with sterilizing and substerilizing doses of gamma – radiation pp. 71 – 95 . In P.B. cornwell (Ed) . The Entomology of Radiation Disinfestation of Grain, Pergamon Press. New York, 236 , P.
- El- Halfawy, M.A. (1977a). Entomofauna of dried medical and aromatical plants with a short note on their occurrence and populations. Agric. Res . Rev. , Cairo, 55 : 103 – 106
- El – Halfawy, M.A. (1977b). Biology of *Lasioderma serricorne* (F) . on certain medical and aromatical dried plants (Coleoptera : Anobidae). Agric. Res Rev, Cairo, 55 : 107 – 110.
- El- Orabi , M. N. ; A. M. Amer and D.M.Y. Shafei (2007). Biological effects of some plants oils, Gamma radiation and their interactive effects on *Callosobruchus maculatus* F . Arab J. of Nuclear and Applications , 40 (3):301-311
- Hasaballa, Z.A. and F.K. Abdel – Kawy (1992). Some factors affecting reproduction in rice weevil, *Sitophilus oryzae* (L) 5th Conf. Nucl. Sci & App., AEA. Cairo . Egypt, 2 : 567 – 574
- Hasaballa, Z.A. and S. M. Abdel – Baki (1990). Type of food and gamma irradiation as factors affecting the Larval growth of *Ephestia kuehniella* (Zell), *Corcyra cephaloni* (Staint) and *Plodia interpunctella* (Hubn) Assiut Journal of Agricultural Science, 21 (1): 215 – 223
- Hassan , S. A. ; Z. A. Ahmed; M. S. Abd-ella and O. H. Gareeb (2002). Impacts of vanillin on development, reproduction and reproductive organs in the rice moth *Corcyra cephalonic* (Staint) (Lepidoptera : Pyralidae). J. Egypt. Ger. Soc. Zool, 37E:25-38
- Misra,U.S.(1981). Nutritional requirements of stored grain insect pests. In " Insect physiology and anatomy " 2nd, Published by Indian Council of Agricultural Research , New Delhi, India p.332
- Ramadan, A.K. Salama and Salwa M. Abdel Baki (1994). Effect of gamma radiation on certain biological aspects of the rice moth, *Corcyra cephalonica* Staint (Lepidoptera , pyralidae). Bull, Ent . Soc. Egypt, Econ, Ser., 21: 235 – 240
- Russell, V.M ; G.G. Schulten and F.A. Roorde (1980). Laboratory observations on the development of the rice moth *C. cephalonica* Staint (Lepidoptera : pyralidae) on millet and sorghum at 28^oC and different relative humidities. Z. Ang . Ent., 89 : 488 – 498
- Samira,E.M. El Nagger; S.A. Hussan and Zamzam A. Ahmed(2001): Biological and histopathological effect of sterilizing gamma irradiation on gonads of *Spodoptera littoralis* (Boised.) (Lepidoptera – Noctuidae). Annals of Agric. Sci., Moshtohor, 39 (1): 685 – 694
- SooHoo, C.F.and G. Raenkel (1966). The consumption digestion and utilization of food plants by a polyphagous Insect, *Prodenia eridania* (cramer). J. Insect Physiol., 12 : 711 – 730

- Thorayia, F.K. El- Naggar; Hoda M. Abdel – Fattah and Zamzam A. Ahmed (1995). Effect of gamma irradiation on the insect development and esterase activity in the confused flour beetle, *Tribolium confusum* (Duv.) Arab Journal of Nuclear Sciences and Applications, 28 (2): 123 – 131
- Thornburn, C.C.(1972). Isotopes and Radiation in Biology. Butterworth and Co., LTd, London, 287 pp.
- Tilton, F.W. ; J.H Brower and R.R. Cogburn (1971). Critical Evaluation of an operational bulb – grain and packaged product irradiator. Int. J. Radiation Energy , 1 (1): 49 – 59
- Tsan , Hu.; Chen – Chiache; Peng – Wukang.; Hu. T.; C.C. Chen and Wk. Peng (2002).The lethal effect of gamma radiation on *Lasioderma serricorne* (Fabricius) (Coleoptera : Anobidae). Formosan – Entomol., 22 (2): 157 – 162
- Waldbauer,G.P.(1968):The consumption and utilization of food by insects. Adv. Insect Physiol., 5:229

تأثير نوع الغذاء وأشعة جاما على معدل النمو اليرقي والتطور والتكاثر لخنفساء السجائر.

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أجري هذا البحث لدراسة تأثير أنواع مختلفة من الغذاء وكذا تأثير أشعة جاما على معدل النمو اليرقي والتطور والتكاثر لحشرة *L. serricorne*. غذيت يرقات حديثة الخروج على كل من دقيق القمح ، الثوم والينسون والكمون – كما عرضت هذه اليرقات لأشعة جاما بجرعات ٢٠ ، ٤٠ ، ٦٠ جراي.

أوضحت الدراسة أن معدل نمو اليرقات يختلف باختلاف نوع الغذاء – حيث كان أعلى معدل للنمو اليرقي عند تغذية اليرقة على الينسون ، وجاء في المرتبة الثانية دقيق ثم الكمون وفي النهاية الثوم.

- فيما يختص بتأثير أشعة جاما على معدل نمو اليرقات فقد وجد أن هناك علاقة عكسية بين جرعات الإشعاع وبين معدل النمو اليرقي في كل أنواع الغذاء المستخدمة ، حيث أنخفض معدل نمو اليرقات مع زيادة الجرعة الإشعاعية.

كما وجد أن هناك انخفاض في نسبة التعذر ونسبة الخروج للحشرات الكاملة في اليرقات حديثة لنفوس – ويزداد للتأثير بزيادة الجرعة الإشعاعية – كما ينخفض تدريجياً كل من عدد البيض ونسبة الفقس وفترة العمر في الحشرات الناتجة بزيادة الجرعة وكانت الإناث أكثر حساسية من الذكور.

قلم بتحكيم البحث

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