

**Inherited sterility in the cotton leaf worm
Spodoptera littoralis, (Boisd.), and changes in
the DNA pattern as a result of using gamma
radiation .**

By
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B.Sc.(Entomology), Ain Shams University.
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Abstract

The present study was conducted to evaluate the effect of gamma irradiation on certain biological aspects of the cotton leaf worm *Spodoptera littoralis* (Boisd.). Laboratory experiments were carried out to investigate the effect of the substerilizing doses of 0, 50, 150, 250, 350 and 450 Gy of gamma irradiation (cobalt and cesium sources) on different generations of *Spodoptera littoralis* irradiated as pupae to study the inherited sterility. A dose level at 450 Gy completely inhibited full pupal development, but the emerged adult at the dose 350 Gy did not lay eggs, whether they were combined with non-irradiated or irradiated individuals of opposite sexes.

The produced adults (P) showed increasing sterility with increasing the irradiation dose. While, their fertility, fecundity, pupation percent and adult emergence were found to be reduced in the parents followed by F₁, but increased in F₂. In all cases, sex ratio was shifted in favor of males.

A significant negative relationship between dose levels and percentage of egg hatching was obtained; [the higher the dose, the lower the percentage of egg hatching]. The percentage of egg hatching resulting from irradiated male pupae was higher than that resulting from irradiated female pupae. Females were more sensitive for irradiation than males.

Cobalt irradiation source was more effective than cesium source.

The effect of gamma irradiation on the DNA pattern of adult male parents, F₁ and F₂ showed alterations among the controls, the treated parents, F₁ and F₂ individuals. Exposure to irradiation caused very frequently the appearance of some extra bands and the deficiency of others in the RAPD-PCR and ISSR amplification pattern of the irradiated insects. The appearance of extra bands was attributed to the repair mechanism that occur in the irradiation damaged DNA.

However, the similarity in DNA patterns between some normal and treated samples was interpreted by assuming that the irradiation induced damage was in regions of the genome other than at the loci under study.

Finally, the isolation of *SpliRep* gene by using the nucleotide sequence and sequence analyses which was fairly identical to one of the well-known repair genes in *D. willistoni* strengthened the putative action of a DNA repair system in *S. littoralis* when it was subjected to DNA-damaging radiation (gamma radiation).

Key words: Gamma Irradiation, inherited sterility, cobalt, cesium, *Spodoptera littoralis*, substerilizing, fertility, fecundity and pupation, N, T, F₁, F₂, cobalt, cesium RAPD-PCR, ISSR, DNA, *SpliRep*, nucleotide sequence and sequence analyses.

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List of Abbreviations

- **DNA : Deoxyribonucleic acid**
- **PCR : Polymerase chain reaction.**
- **RAPD-PCR : Randomly amplified polymorphic DNA**
- **ISSRs : Inter simple sequence repeats**
- **P: Parents**
- **F₁ : First Filial generation.**
- **F₂ : Second Filial generation.**
- **N :Normal.**
- **T :Treated.**
- **Gy: Gray.**
- **Krad = kilo rad =10 Gray.**
- **G : Guanine.**
- **C : Cytosine.**
- **T : Thymine.**
- **A :Adenine.**
- **Bp : base pair**

CHAPTER I
INTRODUCTION
AND
AIM OF THE WORK

I. Introduction.

Spodoptera littoralis (Lepidoptera:Noctuidae), is an economically serious and polyphagous pest in Egypt. This pest is reported to attack a wide range of food plants (112 cultivated plants belonging to 44 families worldwide and 60 plants in Egypt) (Moussa *et al.*,1983).

A multifaceted approach is required for the control of this pest because it has developed resistance against a range of insecticides and because other control measures are inadequate when applied alone (Ramakrishnan *et al.*,1984; Armes *et al.*, 1997). The sterile insect technique (SIT) has been used for Lepidoptera but insects in this order are radio-tolerant, presumably due to their holokinetic chromosomal configuration (Bauer, 1967). Therefore, lepidopterans require large doses of radiation for sterilization, leading to somatic damage and reduced competitiveness in the irradiated insect. A favored alternative to use fully sterile moths in SIT is the use of F₁sterility. F₁ survivor progeny of sub-sterile parental (P) male moths resulted when sub-sterilizing doses of radiation are applied to the parent males. The resulting F₁progeny are more sterile than the irradiated parent, and the irradiated moths are more competitive as a result of receiving a lower dose of radiation. Lepidopteran females are usually

more sensitive to radiation than males of the same species. This allows the radiation dose to be adjusted to suit programme requirements. When partially sterile males mate with wild females, the radiation-induced deleterious effects are inherited by the F₁ generation.

Inherited sterility in the progeny of treated males has been shown to have potential in suppressing populations of lepidopteran pests (**Knipling, 1970; La Chance, 1985**). Previous studies of substerilizing gamma-radiation doses on the growth and reproductive behavior of *S. littoralis* in the F₁ progeny of treated moths indicated the potential of managing this pest by using inherited sterility (**Seth & Sehgal, 1993**).

DNA is associated with the transference of genetic information from cell to cell, while RNA is associated with their transference within the cell and with the protein synthesis. Therefore, the departure of these genetic controlling factors from the normal way affect the fecundity and fertility of the insects (**La Chance et al., 1970**).

DNA is generally accepted that the main target of biological significant radiation damage on the cell is the DNA,

At least three types of DNA lesions, produced both in vitro and in vivo, have been recognized after exposure to ionizing irradiation:

- 1- Strand breaks, both single and double.