*Andhra Pradesh J Agril. Sci* : 7(4): 198-203, 2021 **EFFECT OF GAMMA IRRADIATION ON THE SURVIVAL AND DEVELOPMENT OF GROUNDNUT BRUCHID, *Caryedon* spp. (COLEOPTERA : BRUCHIDAE)**

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Date of Receipt: 26-07-2021 Date of Acceptance: 29-09-2021 **ABSTRACT**

A study was conducted on the effect of gamma irradiation on survival and progeny development of groundnut bruchid, *Caryedon* spp. (Coleoptera : Bruchidae) 2020-21. Freshly emerged adults were exposed to different doses of gamma irradiation *viz.*, 10, 30, 50, 100, 250 and 500 Gy along with an untreated control. Five days after gamma irradiation, all the adult bruchids were killed at 250 Gy and higher doses compared to 100 per cent survival in the untreated control. All the irradiated adults laid the eggs in the range of 172.33 to 89.67 eggs between 10 Gy to 100 Gy doses compared to 237 eggs/100 pods in untreated control. The sterile eggs were laid by the irradiated adults and there was no embryonic development from the dose of 30 Gy onwards. Bruchid emergence was not recorded from 20 Gy dose onwards. Hence, the groundnut bruchids require 250 Gy for acute mortality within five days of treatment but 30 Gy dose is sufficient to induce sterility in adults and in suppressing the F1 population build up in groundnut. Gamma irradiation was proved to be an effective alternative measure for the management of *Caryedon* spp. in stored groundnut.

**KEYWORDS:** Groundnut, Gamma irradiation and Gy.

**INTRODUCTION**

Groundnut (*Arachis hypogaea* L.), is the major oilseed crop in India which is widely grown for its high quality edible oil and food use in the tropical and subtropical regions of the world. Globally, India ranks first in groundnut area and the second largest producer with 101 lakh tonnes with a productivity of 1816 kg ha-1 in 2020-21 (Anonymous, 2021a) Groundnut outlook report, 2021). In Andhra Pradesh groundnut is cultivated in 6.61 lakh hectares with a production of 8.50 lakh tonnes and productivity of 1285 kg ha-1 (Agricultural statistics at a glance - A.P., 2019-20). Indian groundnut has great export potential and exported 6.38 lakh tonnes which earned about 5381 crores during 2020-21 (Anonymous, 2021b).

Groundnut bruchid, *Caryedon* spp. is the most potential and economically important insect pest contributing significant post-harvest losses and deterioration of seed quality in stored groundnut (Redlinger and Davis, 1982). It is the only insect pest that can infest kernels inside the intact pods (Devi and Rao, 2005).

Groundnut has a greater export potential and the groundnut bruchid is an important quarantine pest which was not reported from many countries. Chemical

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insecticides such as fumigants, disinfectants and grain protectants are powerful components in stored grain pest management. Over the past three decades, with the gradual phase-out of methyl bromide there has been an over reliance on phosphine fumigation. Due to continuous usage of phosphine fumigation in storage godowns, phosphine resistance has been increased in frequency, distribution and strength in many storage pests and that was worsened further by the lack of suitable alternatives (Nayak *et al.,* 2019).

Interest in the use of gamma irradiation as a phytosanitary treatment for agricultural commodities is growing worldwide particularly since the publication of the International plant protection convention standard that endorses and facilitates trade based on this disinfestation method (Follett *et al*., 2007; Gasemzadeh *et al.,* 2010). Gamma irradiation may be an effective and economically feasible alternative method for disinfestation of insects (Tilton and Brower*,* 1987).

The advantage of gamma irradiation over chemical fumigation has been demonstrated extensively as it is residue free treatment (Tuncbilek, 1995). Most insects can be controlled with doses of less than 0.3 k Gy but some stored product moths may require doses as high as 1 k

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Gy (Follett and Neven, 2006). The information on the effective dosage of gamma irradiation for the control of *Caryedon* spp. in groundnut is very scanty. So, present study of management of groundnut bruchid, *Caryedon* spp. using gamma irradiation technique is proposed and conducted.

**MATERIAL AND METHODS**

The insect culture of *Caryedon* spp. was collected from groundnut storage godown of Regional Agricultural Research Station, Tirupati, Andhra Pradesh. The obtained insect culture was maintained under laboratory conditions on locally available groundnut variety, Dharani. For mass multiplication of the bruchid adults, about twenty-five pairs of adult beetles were released into plastic containers (30x15 cm) containing 1 Kg of disinfested groundnut pods and the mouth of the container was covered with muslin cloth and tied with rubber bands. The jars were kept undisturbed under laboratory conditions till the emergence of F1 adults. The bruchids were mass multiplied in the laboratory for about 4-5 generations and the freshly emerged adults were used in the studies. Adult bruchids were exposed to gamma radiation at different dosages *viz*., 10 Gy, 30 Gy, 50 Gy, 100 Gy, 250 Gy and 500 Gy by a Cobalt-60 Gamma irradiator (Gamma Chamber 5000) facility available at ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru. The irradiated insects were released in to the plastic containers and fed with groundnut kernels. An untreated control without subjecting to irradiation was maintained for comparison. The observations on adult mortality, number of eggs laid per 100 pods, number of F1 adults emerged were recorded.

**RESULTS AND DISCUSSION**

The Mortality of *Caryedon* spp. adults was recorded at 1, 3, 5, 7, 10, 15 and 20 days after gamma irradiation treatment (Table 1). One day after treatment, no mortality was recorded up to 50 Gy dose but mortality was recorded as 1.67, 10.00 and 23.33 per cent at 100, 250 and 500 Gy respectively.

Three days after treatment, there was no mortality in adult *Caryedon* spp.in untreated control and the irradiated adults up to 50 Gy, while mortality was recorded as 8.33, 41.67and 68.33 per cent at 100, 250 and 500 Gy, respectively. Five days after treatment, 100 per cent mortality was observed at 250and 500 Gy whereas, mortality was observed to be 31.67per cent at 100 Gy compared to nil mortality in untreated control (Figure 1).

Seven days after treatment, no mortality was recorded in untreated control and at 30 Gy dose. The mortality recorded was 6.67 and 61.67 per cent at50 and 100 Gy, respectively. 100 per cent mortality of *Caryedon* spp. was recorded at 250 Gy.

Ten days after treatment, mortality recorded was 10.00, 23.34, 33.34 and 83.33 per cent in 10, 30, 50 and 100 Gy, respectively. There was 100 per cent mortality at 250 Gy compared to 6.67 per cent mortality in untreated control. Fifteen days after treatment, the mortality per cent recorded was 16.67, 26.67, 53.34 and 70.00 per cent at 0, 10, 30 and 50 Gy, respectively. 100 per cent mortality was observed at 100 250 Gy compared to 16.67 per cent mortality in untreated control.

Twenty days after treatment, 93.34 per cent mortality was recorded at 10 Gy. There was 100 per cent mortality observed in all other irradiation doses compared to 86.67 per cent mortality in untreated control.

**Effect of Gamma Irradiation on Oviposition of Irradiated Adults**

The number of eggs laid by the irradiated bruchid adults decreased gradually with the increase in irradiation dosage. The highest eggs laid by the irradiated adults were 172.33, 136.00, 118.67 and 89.67 eggs/100 pods at 10, 30, 50 and 100 Gy doses, respectively. No oviposition was observed by the irradiated adults at 250 Gy compared to 237.00 eggs/100 pods in untreated control (Table 1 and Figure 2).

**Effect of Gamma Irradiation on F1 Adult Emergence**

The number of emerging F1 adults decreased with increased irradiation dose and the adult emergence was stopped at 30 Gy. F1 adult emergence noted was 74.82 and 11.61 per cent at 0 and 10 Gy, respectively. This shows that sterile eggs were laid by the irradiated adults from 30 Gy onwards.

Five days after treatment, 100 per cent mortality was achieved at 250 Gy which was found to be effective in controlling adults of groundnut bruchid *Caryedon*spp*.* No eggs were laid by the irradiated adults at 250 Gy. Sterile eggs were laid by the irradiated adults at 30 Gy from which the adults were not emerged out. Irradiation dose of 30 Gy was found to cause complete sterility in *Caryedon* spp*.* (Table 1 and Figure 2).

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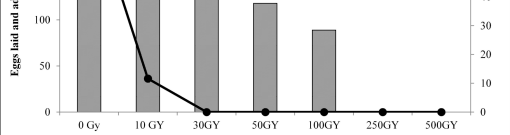
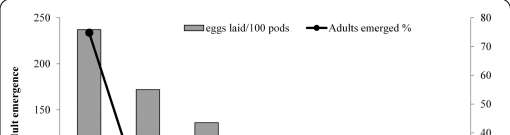
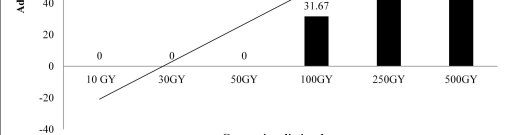
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According to Tilton and Brower (1987), a dosage of 500 Gy would effectively control all stored product pests by inhibiting reproduction or adult emergence rather than causing acute death, which would need considerably larger doses. Higher doses of radiation were necessary to cause insect mortality but low doses of radiation can cause insect sterilisation or genetically damaged gametes (Molin, 2001). According to Tilton (1974), the dosages necessary to sterilise stored product insects might vary greatly, with the *Callosobruchuschinensis* requiring 70 Gy. Similar results were reported by Hussain and Imura (1989) that a dose of 640 Gy caused instant kill of the mature pupae and one day old adults but complete sterility was obtained at 80 Gy in the 1-day old adults of *C. chinensis*.

According to Boshra (1994), gamma radiation dose required to sterilize *C. chinensis* adults was 120 Gy. According to the International Atomic Energy Agency (IAEA 2002), 100 Gy is the minimum dosage necessary to sterilise *C. maculatus* adults. Soumya *et al*. (2017) suggested that 50 Gy was the optimal dosage for inducing sterility in *C. chinensis*. According to Hammad *et al.* (2020), at a dose of 1250 Gy no emerging adults were seen but 650 Gy is sufficient for suppression of F1 population.

Gamma irradiation was found to be an effective technique to control the groundnut bruchid, *Caryedon* spp. in stored groundnut. A dose of 250 Gy effectively controlled the bruchid insects with 100 per cent adult mortality after five days of exposure to gamma radiation. The egg laying of irradiated adults was totally stopped at 250 Gy dose. But the low dose of 30 Gy was optimal dose to induce sterility in bruchid female insects to lay sterile eggs and complete inhibition of reproduction and F1 adult emergence. Gamma irradiation of ground nut pods is the viable alternative to phosphine fumigation which can be explored for exporting bruchid free groundnut consignments to other countries.

**ACKNOWLEDGEMENTS**

The authors would like to thank the ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru for providing Cobalt-60 Gamma irradiator (Gamma Chamber 5000) facility and thanks are also to Acharya N.G. Ranga Agricultural University, Guntur for all the facilities extended during the period of my study.

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