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Effect of Gamma Irradiation on Tasar Silkmoth, *Antheraea mylitta*.D

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Abstract : *Antheraea mylitta*.D. is a wild sericigenous and polyphagous insect which feeds on *Terminalia arjuna* and *Terminalia tomentosa*. It has an exclusive race in this region known as Andhra local. Due to certain weaknesses in acclimatization at different stages, this ecorace is showing signs of extinction. Present communication is based on indoor rearing of Andhra local and studies on morphological and physiological aspects of egg, larva, moth, pupa, cocoon and fibre quality. A comparison was made on the effect of various levels of gamma irradiation on the moth of irradiated cocoons. The effect of irradiation on moth and pupal duration was also observed. The results have shown that the moths of indoor rearing are at par with that of outdoor reared ones. Irradiation of cocoons during diapause showed a dose-dependent, significant reduction with 5 Gy (500), 7.5 Gt (750) and 10 Gy (1000 RADS), in the pupal duration and increase in the duration of the moth stage. The irradiated cocoons have also shown changes in filament structure.

Key words : *Antheraea mylitta*, Indoor rearing, Gamma irradiation, Moth and pupa.

Introduction

Antheraea mylitta Drury, Andhra local ecorace is an exclusive race of Andhra Pradesh. Earlier some scientists have reported limited positive response of *A. mylitta* for indoor rearing. However more efforts are to be made in this direction to rear from chawki stage to the cocoon stage. The available literature shows that Thangavelu *et al*. (1992) have reported indoor chawki worm rearing of *A.mylitta* with an estimated ERR (Effective rate of rearing) of less than 20%. Though the findings are not encouraging, one aspect apparently becomes clear that *A. mylitta* is not averse to indoor rearing. Therefore, an attempt has been made to rear the insect from first instar to the last instar and allow it to go for cocoon spinning also. Present report gives details of the moth weight with reference to outdoor and indoor rearing.

A few workers have attempted to study the effect of irradiation on respiration and food consumption (Buscarlet, 1983), flight behaviour and mating competitiveness (Chung *et al*., 1971, Huque *et al.*, 1973, Earle and Simmons, 1979). Earlier, studies were carried out on the impact of insecticides following irradiation (Adem and Waltens, 1985) and irradiation induced cytological, histopathological and histochemical changes (LaChance and Ruud, 1977 ; Srivastava *et al*. 1985). The effect of UV and gamma irradiation on heartbeat of *B.mori* was investigated (Sammaiah, 1985).

In the present investigation, the diapause cocoons of tasar silkworm, *Antheraea mylitta*, D (Andhra local ecorace) were subjected to gamma irradiation, following which its effect on moth's morphology and cocoon characters were studied. Since environment has a direct influence on the

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cocoon surface, sun rays, which is known to possess ultraviolet. In the present studies, cocoons are studied by exposing them to gamma rays and observing their effect on the filament. The present report shows the effect of gamma irradiation on the moth emerged from irradiated cocoon.

Material and Methods

The total indoor rearing of *Antheraea mylitta*. D, (Andhra local ecorace) was done in the rearing set up consisting of rearing set up consisting of conical flasks. Immediately after brushing, young worms were released on the branches of host plants which were cut and placed in the conical flasks containing water. A hardbound sheet was placed on the neck of the flask exposed. A paraffin sheet was covered on the hardbound sheet to collect the faecal pellets and to maintain cleanliness and healthy atmosphere in the rearing set-up. Proper ventilation, temperature and humidity were ensured in the rearing room. Tender and juicy leaves were provided to the young larvae and mature leaves to the adult worms. Brushing was done according to improved technique of using only one-day hatching to maintain uniformity and avoid overcrowding. During moulting, care was taken not to disturb the arrangement. When the worms were out of moult, the branches were replaced.

A comparison is made between moths of outdoor and indoor reared tasar silkworm. Using Dhona balance, the weight of the moths has been taken. For this purpose, wings are cut from the body by using a scissors. The weights of wings and the body are taken separately and then added. This gives the weight of the moth. Before taking the weight, the sex of the moth was noted down. The average weight of each of five females and males were taken.

In order to irradiate the cocoons, Gamma Irradiation Chamber 900 model of Bhabha Atomic Research Centre, Bombay was used. Three diapause cocoons (which were selected from field/outdoor rearing) at a time were selected and kept in the sample chamber and irradiated at three dosage levels- 5 Gy (500) RADS; (40 secs), 7.5 Gy (750) RADS; (60 secs) and 10 Gy (1000) RADS; (80 secs).

Results

The average weight of five male moths of outdoor reared *A.mylitta* (Andhra local) in the three crops were 1.45, 1.49 and 1.42 gms, whereas that of females were 2.15, 1.99 and 2.18 gm. The average weight of male moths of indoor reared larvae in the three crops were 1.44, 1.62 and 1.29 gm, whereas that of females were 2.08, 2.05 and 2.09. It is observed from the results, that, male and female moth weights of outdoor reared

Table 1 : Average moth weight of Tasar silkworm *Antheraea mylitta* (Andhra local) during three crops (in grams)

Crop	Sex	Outdoor rearing	Indoor rearing
I	Male	1.45	1.44
	Female	2.15	2.08
II	Male	1.49	1.62
	Female	1.99	2.05
III	Male	1.42	1.29
	Female	2.18	2.09

Table 2 : Pupal and moth duration of irradiated cocoons of tasar silkworm *Antheraea mylitta* (Andhra local) reared under outdoor conditions

S.No	Dosage	Sex	Pupal duration after treatment (days)	Moth duration of life (days)
1	5 Gy (500 RADS)	Female	30	3
		Male	28	16
2	7.5 Gy (750 RADS)	Female	14	5
		Male	11	8
3	10 Gy (1000 RADS)	Female	12	6
		Male	10	10

Fig. 1 : Normal female and male moths of *A. mylitta*.D (Andhra local)

Fig. 2 : 5 Gy (500 RADS) Irradiated moth of *A. mylitta*.D, showing folded wings

Fig. 3 : Moths showing faded and dull wing colour and gradual decrease in the wing size from 7.5 Gy (750 RADS) to 10 Gy (1000 RADS) (*A. mylitta*, Andhra local)

larvae were slightly greater that those of indoor reared ones except in the second crop (Table 1).

In the moths of cocoons irradiate at 5 Gy (500 RADS), the size of the wings and the body were smaller than that of normal ones (Fig. 1). The wing size had gradually decreased from first category to third category of radiation.

In the moths of first category (Fig. 2), both the wings were folded, whereas in the second type (Fig 3), only the left wing was folded while in the third type, the wings were not only folded, but they were deformed and narrow in shape. The wings have shown high beating frequency and there was a loss of scales. The colour of wings of first and second category moths was normal while that of third category was faded and dull (Fig 3).

Comparatively, the male moths have survived for more days than those of females by 3-13 days (Table 2). They have also shown better flight and movement than female moths. The females of three categories have shown egg-laying before fertilization. The rest of the features like colour of the moth, head, antennae and legs were normal in the three categories of the moths.

Discussion

The average weight of female and male moths for three crops show that in both sexes for I and II crops the weight of the moths from outdoor rearing were higher than corresponding indoor worms. However, in the second crop weight of male and female moths in the indoor reared worms is more. Generally, increase in the weight of moth suggests the weight of reproductive system. Particularly, it is taken as an index for fecundity in the female moths. Therefore, though not significantly high, the first and second crop seasons fecundity of outdoor reared worms is found to be more than in the II crop season.

Kawahara *et al*. (1994) have observed swelling behaviour of silk fibre due to X-ray scattering. Changes in the hue in the raw silk fibre of *Antheraea yamamai* due to UV irradiation and heat treatment was reported

(Kawahara, 1996). A change in the fine structure of silk fibroin fibres due to gamma irradiation was reported by Tsukada *et al*. (1994). It is also observed that the effect of radiation is evaluated mainly by exposing the live material of the silkworm during egg stage (Abdel Salam and Mahamood, 1995; Ram Mohan Rao *et al*., 1994; Khan and Khan, 1990; Grekov, 1995), larval stage (Tazima, 1978; Lakshmi Kumari *et al*., 1994).

Studies on the moth emerged from the irradiated cocoons have shown certain abnormalities as compared to the normal moth. As the dose was increased, these abnormalities were also deepened. Particularly, the size of the moth was smaller than the size of the normal, wings have shown maximum effect of the radiation with size reduction and folding, colour fading, body shape deformed, scales falling, wings with high beating were the behavioural changes observed. Pupal duration was considerably reduced. Differential sex susceptibility showing radiation resistance by males at all the dose levels was found.

Several attempts have been made earlier to induce beneficial mutations through irradiation in the silkworm and some have proved to be useful to sericulture industry. The initial investigations were concerned with sensitivity changes in germ cells during the development. The radiation genetics of silkworm such as dose rate effects, process of recovery from damage, risk estimates etc were studied by other workers.

Tazima (1978) has dealt with the effect of radiation and mutagenesis in silkworm. In general sensitivity to radiation is very high in embroyonic stage, moderately high in the larval stage. As the dose level increases rapidly in the pupal stage and adult becomes strikingly resistant. Breakage of dormancy in the silkworm is due to radiation effects as reported by Akita *et al*. (1965). However, the radiosensitivity of the eggs was variable in relation to the duration of their incubation.

Thus, it is abundantly clear that there is scattered information available on the effect of radiation in relation to cocoon characters. Mallik (1993) have reported effect of gamma radiation on some technologic properties of cocoons and filament of *B.mori*. (Tsukada *et al*., 1994) have reported changes in the fine structure of silk fibre following gamma radiation. Singh *et al*. (1990) has observed changes in the cocoon weight, silk weight and other economic characters due to radiation. They have also reported higher sensitivity of silkworm *B.mori*. It is abundantly clear that exposure of the silkworm during early stages of development leads to more adverse effects including on the silk fibre quality.

Change in colour and loss of luster were the visible changes found following irradiation, where reeled filament turned to dark in colour.The filaments have shown dose-dependent changes regarding level of dents and decrement in diameter. In the filament at 5 Gy, the breakages are from the periphery to the lumen of the filament. At 7.5 Gy, the fibrils of the filaments are found to be loose with breakages from the periphery and lastly at 1000 RADS, the fibrils are separated out with localized disintegration of fibroin giving a granular appearance (Shamitha and Rao, 1999)

Conclusion

The weights of moths, both sexes, showed a decrease in outdoor worms except in the second crop. Irradiation of cocoons during diapause showed a dose-dependent, significant reduction with 5, 7.5 and 10 Gy, in the pupal duration and increase in the duration of the moth stage. Effect on silk filament quality and structure are also noted with radiation.

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