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[Short Communication]

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Stimulation of Fecundity through Antennal Amputation in the Mulberry Silkworm, *Bombyx mori* L.

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Stimulation of fecundity following female antennal amputation has been reported for the first time in silkworm. Antennal amputation caused significant increase in fecundity in two newly evolved multivoltine silkworm breeds *viz*., BL 67 and 96A. This study indicated better chances for increasing egg yield and the increase in fecundity may be attributed to the action of some neurohormones. Significance of antennal amputation in silkworm has been discussed.

Key words: Antennal amputation, *Bombyx mori*, Fecundity

Introduction

Antennae in insects primarily function as sense organs (Schafer and Sanchez, 1976) and olfactory receptors (Kaissling, 1971; Wilson *et al.*, 2004). In addition, antennae function as taste organ, tactile function, feelers, smell, navigate, regulation of air speed in flying insects, assist in mating etc. (Chapman, 1998). In the mulberry silkworm, *Bombyx mori*, the capacity of an antenna for sensilla is increased through lateral branches of the flagellar subsegments (Zacharuk, 1985). In the silkworm, there are one pair of dark brown prominent antennae on the head. Each antenna consists of 35 – 41 sub-segments whose number varies according to strain of silkworm (Steinbrecht, 1970). In European races, the number of antennal sub-segments is larger than in Japanese races. Even in the same race, the moths which lay diapause eggs possess more sub-segments than those which lay non-diapause eggs. Usually the size of the antennae is larger in males as compared to females (Aruga, 1994). Surface area, size and volume of antennae play some important role in controlling the number and distribution patterns of flagellar sensilla. It has been estimated that basic antennal surface area of male and female *Bombyx* are 24 mm^2 with 24,5000 sensilla and 19 mm^2 with 16,000 sensilla respectively (Steinbrecht, 1970). No information is available on the function of antennae in relation to oviposition and fecundity in silkworm. Hence, the present authors, for the first time, proposed to stimulate fecundity through antennal amputation in the mulberry silkworm, *B. mori.*

Materials and Methods

Two newly evolved multivoltine silkworm breeds namely BL 67 and 96 A were utilized in the present study. In both the breeds, female cocoons were separated and pupae were assessed individually on an electronic balance. Female pupae were grouped into low, medium and high batches. In case of BL 67, low (1.000 – 1.050 g), medium (1.200 – 1.250 g) and high (1.300 – 1.350 g) whereas in case of 96 A, low (0.750 – 0.800), medium (1.000 – 1.050 g) and high (1.100 – 1.150 g) batches were made. Female moths in each batch, after emergence, were mated with freshly emerged males. A fairly large number of males were kept for effective crossing. Grainage operations were carried out at room temperature of 25°C ± 1°C and 75% relative humidity. In each group, females were mated for three hours. The antennal length in the breeds under study was 9 mm in males whereas it was 6 mm in female moths. Soon after decoupling, both the antennae of female moths were amputated with the help of sharp scissors at about 2 mm from the basal part of the antennae. Each group was replicated thrice with 8 – 10 moths per replication. The experiment was repeated twice during November - December, 2002 and January - February, 2003. Data were

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recorded and analyzed for fecundity and hatchability and compared with respective non-amputated batches.

Results and Discussion

Silkworm seed production has been one of the priority sector of Indian silk and presently, India requires about 30 crores of commercial disease free layings (dfls) eggs in a year. Egg production in silkworm is under the influence of several factors like mating duration (Jadhav and Gajare, 1978; Benchamin *et al.*, 1990), cocoon weight (Ravindra Singh *et al.*, 1994a), female pupal weight (Jayaswal *et al.*, 1991; Singh *et al.*, 1994), temperature and relative humidity (Puttaswami Gowda, 1988), various chemicals like ascorbic acid (Rahman *et al.*, 1990), hydrogen peroxide and aspirin (Ravindra Singh *et al.*, 1994b) etc.

Effect of antennal amputation on fecundity and hatching % in BL67 and 96A during November - December, 2002 and January February, 2003 has been given in Table 1 and 2 respectively. It was found that antennal amputation stimulated highly significant ($p < 0.01$) increase in fecundity in low, medium and high batches of BL67 in both the seasons whereas, significant ($p < 0.05$) increase was observed in low, medium and high batches of 96A except high batch of 96A showing highly significant ($p < 0.01$) increase during January - February, 2003. Medium batch of BL67 and low batch of 96A exhibited significant ($p < 0.05$) increase in hatching during November - December, 2002 whereas, it was highly significant ($p < 0.01$) in high batch of BL67 and medium batch of 96A. There was no significant difference in hatching % except in high batch of BL67 during January - February, 2003.

Antennae are considered as nostrils in insects and in mulberry silkworm, sieve-like bipectinate antennae are well suited to trap odor molecules (Zacharuk, 1985). The sensilla present on the flagellum of most insects are olfactory in function having variety of forms and are common for contact chemo-receptors, mechanoreceptors and thermohygoreceptors. Contact chemoreception has been studied to induce oviposition in *Pieris* butterflies by glucosinolates compounds (Chapman, 1998). Morohoshi *et al.* (1977) have studied the routes of different neurosecretary cells in the brain of silkworm larvae by using cobalt staining method and they found four groups of secretary cells. The I group consists of two types of cells (4 large and 5 – 6 small). II group consists of a total of about 15 large and small cells. III group consists of two cells present at the tip of the brain and they stimulate the cells of I group. The IV group consists of 3 neuro secretary cells located laterally. Morohoshi (2000) reported that 3 cells of group IV in the hind brain are directly linked to the antenna on the head and their secretion passes through outer axon and reaches the corpus cardiacum where it stimulates the organ and regulates its function.

In the present study, antennal amputation stimulated significant increase in fecundity and hatching % in silkworm. In some moths, egg laying was initiated soon after antennal amputation. Increase in fecundity may be due to action

Table 1. Effect of antennal amputation on fecundity and hatching % in silkworm, *Bombyx mori* L.

Breed/ Category	Control/ Amputated	Fecundity	Hatching %
November-December, 2002			
BL67 (Low)	Control	468	95.33
BL67 (Low)	Amputated	521	96.15
BL67 (Medium)	Control	499	95.93
BL67 (Medium)	Amputated	560	97.45
BL67 (High)	Control	539	96.02
BL67 (High)	Amputated	610	97.76
96A (Low)	Control	348	94.26
96A (Low)	Amputated	393	95.91
96A (Medium)	Control	376	94.50
96A (Medium)	Amputated	417	96.17
96A (High)	Control	483	95.21
96A (High)	Amputated	530	96.08
F Test	-	**	**
CD at 5 %	-	37.0	1.25
CD at 1 %	-	48.9	1.66
January-February, 2003			
BL67 (Low)	Control	479	98.12
BL67 (Low)	Amputated	529	97.60
BL67 (Medium)	Control	530	97.99
BL67 (Medium)	Amputated	580	98.02
BL67 (High)	Control	610	97.69
BL67 (High)	Amputated	655	98.27
96A (low)	Control	412	97.39
96A (low)	Amputated	452	97.42
96 (medium)	Control	482	97.71
96A (Medium)	Amputated	515	98.10
96A (High)	Control	497	97.67
96A (High)	Amputated	542	97.69
F Test		**	*
CD at 5 %		30.8	0.55
CD at 1 %		40.8	0.72

* and ** denote significantly different at 5% and 1% level respectively.
Values in parentheses indicate percent improvement over control.

of some neurohormones. However, further studies are required to reach the final conclusion. This study may give some indication towards the stimulation of fecundity in silkworm following antennal amputation and about 10% increase in fecundity has been observed. Studies should also be initiated to increase fecundity in other types silkworms *viz.*, oak tasar, tropical tasar, eri and muga where low fecundity is one of the major constraints.

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