FECUNDITY, EGG FERTILITY AND HATCHABILITY RESPONSE OF SILKWORM, *BOMBYX MORI* ON DIFFERENT SUBSTRATA

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Abstract

Response of two strains of mulberry silkworm, *Bombyx mori* was worked out for fecundity, egg fertility and hatchability on different textured and colored substrata. Five (05) topographically different textured papers namely, art paper (glossy), off-set (fine), flying paper (smooth), newspaper (coarse), craft paper (control) and six (06) colors, i.e. black, green, pink, white, yellow, brown (control) in smooth texture (flying paper) were evaluated. C-102 laid mean maximum (375.8eggs/female) as well as fertilized eggs (370.4) on craft paper while hatchability was the highest on flying paper (95.4%). Among colors, the highest total eggs per female (407.6), fertilized eggs (395.0) and hatchability (94.6%) were recorded on black color. On the other hand, 206-PO deposited mean maximum number of eggs (380.9), fertilized eggs (373.8) with hatchability (93.96%) on flying paper. Similar returns were received on brown color. For C-102 the best alternative for craft paper was flying paper and for black color was brown whereas that was vice versa for 206-PO. Newspaper and pink color gave poor results for both strains. Based on these results it is therefore recommended that for good quality silk seed production craft paper in black color and flying paper in brown color may be used for C-102 and 206-PO, respectively.

Key words: Fecundity, fertility, hatchability, silkworm, *Bombyx mori*, substratum, color, texture.

Introduction

Spreading of sericulture both vertical and horizontal rely on the availability of timely large scale quality silk seed. Quality silk seed enhances the production of commercial cocoons and consequently raw silk. Production of silk seed can be escalated either by amassing large number of laying or extracting maximum fertile eggs of good hatchability potential of the exiting rearing with integrated approach. The former being costly investiture and the latter is just slight manipulation of egg production techniques.

Fecundity, fertility and hatchability are complex physiological phenomena depend upon a number of intrinsic and extrinsic factors inter alia genetic make up, neural,

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hormonal, environmental, behavioral, etc. For instance, fecundity and egg hatching of silkworm varies with rearing season and race (Benchamin, *et al*., 1990; Katti, *et al*., 2001; Radhakrishnan, *et al*., 2001); nutrition, atmosphere, mating and egg laying conditions (Yakoyama, 1963; Siddhu, *et al*., 1967); mating duration (Askari and Sharma, 1984; Tayade, *et al*., 1987; Rahman and Khan, 2005). Also hatchability is profoundly affected by storage conditions (Kamble, 1998); light and temperature during incubation (Sivarami, *et al*., 1998) and delayed brushing of black-boxed eggs (Muniraju, *et al*., 2001). Besides, number of eggs laid by a female is also subjected to the texture of substratum (Gupta, *et al*., 1990; Singh and Saratchandra, 2004); texture and color of substratum (Nangia and Ramakumar, 1997).

Though fecundity is influenced by varying substrata however, literature is scanty on egg fertility and hatchability response on different substrata in combination with fecundity. Present study therefore, was carried out to find out appropriate substratum for higher fecundity, egg fertility and hatchability of two promising silkworm strains.

Materials and Methods

Two bivoltine Chinese pure line strains, *viz*., C-102 and 206-PO of mulberry silkworm, *Bombyx mori* L. were utilized to evaluate fecundity, egg fertility and hatchability response on different textured surfaces and colors during the spring rearing season. Neonates were reared following covered method under 27±1ºC and 85±5% relative humidity up to 2nd moult. Third, fourth and fifth stadia were brought up under 25±1ºC, 80±5% RH, 24±1ºC, 75±5%RH and 23±1ºC, 70±5%RH, respectively. Leaves of bushy mulberry, *Morus alba* cultivar PFI-I were fed five times a day, i.e. 0600, 1000, 1400, 1800, 2200 hours.

Five (05) topographically different textured papers namely, art paper (glossy), off-set (fine), flying paper (smooth), newspaper (coarse), craft paper (control) and six (06) colors, i.e. black, green, pink, white, yellow, brown (control) in smooth textured paper (flying paper) were evaluated for mean number of eggs per female, number of fertilized eggs per female and hatchability percent . Sex separation was ascertained at pupal stage and male & female pupae were kept in separate wooden trays. After emergence female moths were assorted in wooden trays followed by pouring of equal number of male moths. A mating time of four hours was given after which pairs were gently decoupled. Ten (10) mated females were kept in cellule on respective substrata. After the completion of oviposition total number of eggs and number of fertilized eggs per female were

counted and preserved at standard conditions in April till coming October. The preserved eggs were incubated in the autumn rearing season at 25±1ºC 75±5% RH for hatchability.

The experiments were carried out in randomized complete block design with three replications. The mean data for various test parameters were analyzed by analysis of variance test (ANOVA) and difference among individual treatments was tested by least significant difference (LSD) test.

Results and Discussion

The mean data of fecundity, egg fertility and hatchability in C-102 and 206-PO on different textured topographies showed an over all highly significant response (Table-1). C-102 laid maximum (375.8 eggs/female) on craft paper (control). Whereas, the mean lowest eggs per female (246.6) were recoded on newspaper. The difference in quantitative oviposition response between art paper (344.5) and flying paper (350); art paper and offset paper (336.1) was statistically non-significant. In case of mean fertilized eggs per female maximum (370.4) and minimum (245.6) eggs were deposited on craft paper and newspaper, respectively. However, the difference between craft paper and flying paper; among art paper, offset paper and flying paper was non significant. Like fecundity and egg fertility a highly significant overall effect of surface texture was found in egg hatchability. The highest (95.4%) and lowest (79.8%) eggs were hatched on flying paper and newspaper, respectively. But the difference among art paper, offset paper and craft paper was non significant.

206-PO laid mean maximum (380.9) and minimum (252.9) eggs per female on flying paper and newspaper, respectively and individually differed significantly with other test substrata. Nevertheless the difference between art paper and offset paper was non significant. Likewise, mean highest fertilized eggs (373.8) on flying paper and lowest (248.3) on newspaper were enumerated. However, the difference between craft paper and flying paper; art paper and offset paper was non significant. Overall variation in hatchability of 206-PO on five test surface textures was highly significant. Flying paper gave the best (93.96%) hatchability while that was the poorest on the newspaper (80.81%). The individual difference among art paper, flying paper and craft paper (control) was non significant.

Table 1. Effect of texture of substratum on fecundity, fertility and hatchability of eggs of silkworm.

Substrata	C-102			206-PO		
	Eggs/ Female	Fertilized eggs	Hatchability	Eggs/ Female	Fertilized eggs	Hatchability
Art paper	344.5** bc	334.7** b	87.6** b	329.8** c	325.1** b	93.86** a
Offset	336.1 c	329.7 b	86.0 b	327.7 c	322.0 b	89.57 b
F. paper	350.0 b	345.2 ab	95.4 a	380.9 a	373.8 a	93.96 a
Newspaper	246.6 d	245.6 c	79.8 c	252.9 d	248.3 c	80.81 c
Control	375.8 a	370.4 a	86.9 b	365.6 b	360.4 a	93.23 a
CD	9.77	31.78	3.44	8.55	16.94	3.11

** Significant at 99 percent level n.s non-significant

- Figures sharing same alphabets in a column are non-significant among themselves

Out come of fecundity, egg fertility and hatchability of two test silkworm strains showed a highly significant variable response with the changing color of the substratum. The mean data of three test parameters revealed an overall highly significant impact of colors. C-102 laid mean total 407.6 (maximum) and 281.1 (minimum) out of which 395.0 and 275 eggs per female were fertilized on black and pink color, respectively. Individually all the test colors differed significantly among themselves for total number of eggs. On the other hand the difference in fertilized eggs on black and brown; brown and green; green and yellow; yellow and white; white and pink was non significant. 94.6 percent eggs of C-102 were hatched when laid on black color followed by green, white, yellow and pink. The difference among black, brown, green, white and yellow; brown, green, pink and yellow was non significant.

A single female of 206-PO on an average deposited total maximum eggs (370.6) on brown paper and minimum (283.2) on pink paper. The difference between green and pink; among black, white and yellow was non significant. Similarly a female laid 363.3 fertilized eggs (maximum) on brown paper and 256.0 (minimum) on pink paper. Individual difference among black, white and yellow was non significant. The results indicated almost the same trend in hatchability as fecundity. The highest 94.0 (brown color) and the lowest 72.2% (pink color) hatchability was obtained. The difference between black and brown; black and white; among white, green and yellow was statistically non significant.

Table 2. Effect of color of substratum on fecundity, fertility and hatchability of eggs of silkworm.

Sub. Color	C-102			206-PO		
	Eggs/ Female	Fertilized eggs	Hatchability	Eggs/ Female	Fertilized eggs	Hatchability
Black	407.6** a	395.0** a	94.6** a	329.1** b	314.4** b	84.4** c
Brown	380.1 b	377.0 ab	91.7 ab	370.6 a	363.3 a	94.0 a
Green	355.5 c	350.0 bc	92.6 ab	283.2 c	276.8 c	92.0 ab
Pink	281.1 f	275.0 e	88.2 b	269.0 c	256.0 d	72.2 d
White	303.0 e	299.0 de	94.5 a	329.7 b	321.2 b	88.6 bc
Yellow	325.9 d	321 cd	90.4 ab	326.6 b	319.9 b	88.3 c
CD	9.96	33.10	4.43	9.69	15.13	4.36

** Significant at 99 percent level n.s non-significant

- Figures sharing same alphabets in a column are non-significant among themselves

The selection and recognition of the oviposition site and induction of oviposition in most insects is the result of different reflex mechanism in which chemical and tactile stimuli play an important role (Szentesi, 1976). It has too been established that ripe eggs may be retained in female abdomen if sequence of oviposition is interrupted (Deseo, 1976). In *B. mori*, a pair of anal papillae on the caudal tip serves as mechanoreceptors to perceive the textural conditions of the oviposition substratum. Similarly oviposition is regulated by myotropic peptide (ovulation hormone) or oviposition stimulating substance (OSS) released by brain. Presenting findings show a negative effect of too coarse and glossy texture with fecundity, egg fertility and hatchability. This might be because of disturbance caused to papillae by coarser surface and subtle detection of glossy texture. Variation in fecundity and egg fertility on different colors may be due to olfactory effect on brain consequently moderating OSS. Also differential moisture and heat absorbing & releasing capacities of textures and colors of the substrata might have affected egg hatchability specifically during incubation. This aspect needs to be further investigated. Present findings are substantiated from Nangia and Ramakumar (1997) and Gupta *et al*. (1990) where they found a varied ovipositional response of *B. mori* on different textures and colors.

Conclusion

In nutshell it is concluded that surface texture and color of substratum have significant influence on fecundity, egg fertility and hatchability in C-102 and 206-PO, two

strains of mulberry silkworm. C-102 laid more total as well as fertilized eggs on craft paper while hatchability was better on flying paper. Among colors black was comparatively better than the other fives. On the other hand in 206-PO total number of eggs, fertilized eggs and hatchability was more on flying paper and brown color. In both strains return of three test parameters was poor on newspaper and pink color. Based on these results therefore, recommended that for good quality silk seed production and flourish of sericulture entrepreneur that craft paper in black color and flying paper in brown color may be used for C-102 and 206-PO, respectively.

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