Entomology

Effect of mating duration on egg laying capacity and hatchibility of polyvoltine races of *Bombyx mori* Linn

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Abstract

Moths of three polyvoltine (multivoltine) races, Pure mysore, C.nichi & hosa mysore of Bombyx mori were used to study the mating duration and use of male moths for repeated mating on fecundity, egg laying capacity and hatchability polyvoltine races of Bombyx mori eggs. No significant difference of fecundity was recorded when moths were allowed to mate 1,2,3,4 and 5 hours duration. However, significantly less viable eggs were not recorded when the mating duration was 3, 4 And 5 hours. It was observed that female's moth that were mated with used males showed no significant differences in egg yield, hatchability and on fertilized eggs. Repeated mating can be followed at the time of shortage of males provided with some rest in between mating.

Keywords: mating duration, multivoltine races (pure mysore, c. nichi & hosa mysore) of silkworm

Introduction

The rearing of silkworms is as the most economically important insects throughout the world for silk production was one of the most important industries in more than thirty countries, especially in China, Japan, Korea, Thailand, India, France, Italy, Bulgaria etc. and in the twentieth century, Brazil. India the homeland of all varieties of natural silk is the cultural heritage of Indians. The sericulture is an agro based industry; the wide range of ecological situation existing in India and varied need of domestic purposes have made it imperative to look back to diversity and its conservation. A class fiber of insect origin, mulberry silk is the end product of sericulture activity and occupies a reputable position in the world. In view of being oldest world trade commodity it has, through all days received a worldwide importance. Despite several attempts of man to create an artificial substitute for this natural thread, none could match its grace, luster, suppleness, lighter weight, durability, tenacity and many other excellent qualities. Sericulture is labor intensive, export oriented; employment creating and income generating agro based cottage industry providing quick return in shorter duration and does not involve utilization of sophisticated machinery. Sericulture rearing are tremendous potential of employment opportunities and capacity of earning foreign exchange. It provides employment to about 65 lakh people in rural areas in the country. Out of which woman constitute about 70 per cent contribution. By producing self employment in rural areas, not only the rural migration is arrested but also the cottage and small industries get established in rural India. One hectare of land under mulberry in terms of productivity yield Rs 80,000 worth of silk, which is quite attractive as compared to the other commercial crops. In addition, it creates employment to 12-13 persons annually in mulberry cultivation, silkworm recycling, twisting and post harvest cocoon technology like weaving and fabrication of implements (Meenakshi sundaram, 1983) [6]. The climate alteration and different races of silkworm with effecting on production level and genotypes stability is a threat to diversity of domestic silkworm. The diversity is to adapt to the change climate brings loss of wild and domestic diversity including loss of crop species, animal breeds, fish stocks, and silkworm races etc. The nature of pre mating phase of insect in highly diverse, in some species there is elaborate courtship behavior while in other it is completely lacking. Temporal aspects of mating in terms of duration and specific time of mating in a day may also have effects on the number of egg laid pattern of egg laying and their viability (Punitham *et al*., 1987) [10]. It was observed that in silkworm approximately 3 hrs mating is sufficient to get a good fecundity and hatchability (Krishnaswamy *et al*, 1973) [5] and (Jadav and Gajare., 1978) [4] reported that four hours mating duration resulted in significant increase in hatching percentage. No organized attempt has been made so far to study the effects of time of mating which reflects certain aspects of circadian rhythm in mating and egg laying or utilization of male for several mating and its effects on egg viability. In the present study an attempt was made to study the effect of different mating duration and using males for repeated mating with rest at 5ºC in different hours on fecundity and hatchability of newly evolved multivoltine races of silkworm.

Materials and Methods

The mulberry silkworm rearing, being completely domesticated, demands specified environmental conditions like 26 ± 1ºC and relative humidity 80 ± 5%RH. It is therefore necessary to evolve measures for economic cooling through selection of proper material for wall and roof fabrication, orientation of building, construction method, design, etc. Further, enough space must be available to carry out leaf

preservation, rearing, late age rearing and moulting. It should also be convenient enough to conduct effective cleaning and disinfection. The experimental mass rearing was conducted to rear three new multivoltine silkworm races like, (Pure mysore, C.nichi & Hosa mysore) of silkworm as per the standard package and practices (Basavaraja *et al*. 1995) [1] by providing most popular mulberry leaf variety are V_1. After harvesting the cocoon, the defective and deformed cocoons from these selected batches were removed and the cocoons which were uniform in shape, size and hardness confirming to racial traits characters were retained. This selection of cocoons was made visual observation. The selected batches of cocoons were cut to remove pupae from them and male and female pupae were separated based on genital marking and preserved separately races wise and covered with saw dust at 26 ± 1ºC and relative humidity 80 ± 5%RH. On the day of emergence, the pupae were exposed to light from at ante meridiem. Moths emerged during this period were collected from all the races and allowed to mate as mentioned below steps.

To study the mating duration the study was made by using all the three races of multivoltine races of silkworm. Soon after the emergence, virgin females and unmated or fresh were collected in different trays and mated at before 8AM. Mating was allowed for 1hrs (H_1), 2hrs (H_2), 3hrs (H_3), 4hrs (H_4), 5hrs (H_5) and 6hrs (H_6) in ten replication for each treatments. Mating duration for 3hrs (H_3) was considered as a control. After those male and female moths were decoupled and females were allowed for egg layings on egg plastic cards covered with individual cellules. Dark conditions were provided during egg layings and allowed to lay eggs up to 24 hours. The laying of all treatments was collected and subsequently acid treatment and incubation period were followed as per recommendation. The data with regard to fecundity, hatchability, number of unfertilized eggs were collected for each treatments and replications.

Other steps of experiments are the males were utilized for mating with virgin females after the rest of 1hrs (H_6), 2hrs (H_7) and 3hrs (H_8). The mated males were preserved at 5ºC. The mating duration with every female was limited to 3 hours and then allowed for egg laying for 24 hours. Data regarding to fecundity, hatchability and un-hatched percentage were recorded to know the effect of using mated males after the rest in different hours. The two experiments were repeated thrice in different seasons and the pooled data subjected at statistical analysis to find out significance.

Results and Discussion

The present investigation of data for mean egg yield of different females after allowing for different mating duration was pooled, analyzed and presented in Table-1. Statistical analysis of data obtained in the experimental batches with different treatments and replications, indicated non-significant results. Therefore, it can be concluded that 3 hours of coupling duration is sufficient instead of 5 hours of mating. However, Das, S.K. (2001) [3] and Narayanan *et al*. (1964) [7] indicated that a mating period of 3 to 4 hours is ideal to maximize production of eggs. Datta, R.K. (2000) [12] and Omura(1938) [8] has shown that mechanical stimuli imported at the time of mating are sufficient to stimulate egg laying. Puttaswamy Gowda (1990) [11] found that 1 hours mating is sufficient to get maximum number of egg layings in 24 hours. In the experiment statistical data lowest percentage of viable eggs was reported in all the H_1 as 91.01% for Pure mysore, 90% for C.nichi and 90.84% Hosa mysore in Table-1.

Table 1: Effect of mating duration on egg yield and viability of multivoltine races of silkworm

Mating dration (hrs)	Pure Mysore Race		C. Nichi Race		Hosa Mysore Race	
	Fecundity no. of eggs	Viable eggs (%)	Fecundity	Viable eggs (%)	Fecundity	Viable eggs (%)
1hrs (H_1)	520	91.01	490	82.01	455	90.01
2hrs (H_2)	525	93.06	492	90.12	460	91.21
3hrs (H_3)	542	96.88	501	95.01	465	95.44
4hrs (H_4)	510	94.90	489	94.09	472	96.13
5hrs (H_5)	518	94.92	511	95.67	480	97.11
CD@5%		2.078	-	2.10	-	2.22
	NS	**	NS	**	NS	**

It may infer that 3 hours mating is sufficient to produce maximum number of viable eggs. Because during this period at least two ejaculations occur this would be capable of fertilizing all the eggs present in females. The ability of male insects to mate with female varies from one to fifty times Sarkar, K *et al*. (2012) [14] and Rockstein, (1974) [13]. If the insect does not feed during its adult life, the number of times that a male can mate becomes much restricted. Therefore the ability of male moths for repeated mating is limited. Even though numbers of workers have suggested the reuse of male moths that were already mated once (Petkov and Georgi, 1979; Benchamin *et al*, 1990) [9, 2] and one has discussed the potency of these moths in continuous mating. In the second experiment females that were allowed to mate with male for the first time, laid to mate with male for the first time, laid maximum eggs in all the races. The egg yield recorded after one hours rest were 505, 490 and 450 respectively for Pure mysore, C.nichi & hosa mysore of silkworm Table-2.

Table 2: Effect of repeated mating of male moths on egg yield and viability of multivoltine races of silkworm

Male used after rest	Fecundity laying of egg number	Hatching of eggs (Hatachibility)	Un hatched egg number %	Un fertilized egg (%)
Pure Mysore Race				
1hrs (H_6)	505	94.99	0.99	4.42
2hrs (H_7)	490	95.88	1.08	3.79
3hrs(H_8)	481	96.10	1.44	2.67
C. Nichi Race				
1hrs (H_6)	490	96.12	1.13	2.99
2hrs (H_7)	470	95.44	1.67	3.01
3hrs(H_8)	465	95.99	1.99	2.33
Hosa Mysore Race				
1hrs (H_6)	450	96.77	0.90	3.13
2hrs (H_7)	430	95.58	1.77	2.89
3hrs(H_8)	410	94.99	2.13	3.01

** NS= not significant.

The result of non-significant difference in fecundity was observed when each one of the once mated male was successively mated with females with lag of time in between (1hrs, 2hrs and 3hrs of rest). However, Suresh Kumar N, 2012 [15]; evaluation of bivoltine breed of silkworm in West Bengal grain age and Benchamin *et al*., 1990 [2] have reported significant decrease in fecundity with the increase of mating. Similarly with repeated mating by males, no significant differences were observed in hatchability of eggs. Thus the present data clearly indicate that the repeated mating performance of male is better when it is used after some rest in between the mating.

Conclusion

Thus, it may conclude that the multivoltine races produce more than 5-6 generation per year. In most of polyvoltine races are the leaf cocoon ratio is higher than the length of the filament is short but cocoon filament is fine and clean with little lousiness with more lustrous. Our results clearly indicate that repeated mating performance of male is better when it is used after some rest in between the mating time of shortage of male moths they can be utilized for multiple mating provided some rest should be given in between the mating and increase production of silkworm egg and good percentage of hatching eggs. This quality of parameters are that must not be ignored when analyzing and deploying silk cocoons, silk filaments or silk-derive biopolymers of different types of multivoltine silkworm races.

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