Study on the relative rearing performances of mutant strains of Antheraea mylitta under outdoor conditions

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Abstract

India environmental conditions are very suitable for the development of sericulture. In the case of Tasar silk production this latter aim is multifaceted and involves finding the best conditions under which to grow Tasar host plants in the most efficient and economical way to harvest the cocoons. This Research Article is an effort to study the relative variations in respect of rearing performances and to study the impacts of zonal differences on the productivity and qualities of tasar cocoons of three mutant strains viz; Am-yellow, Am-blue and Am-almond of tasar silk worm, A. mylitta D. along with the control (Am-Green) during the seed crop season in respect of percentage of E.R.R., cocoon weight, shell weight, shell ratio, filament length of tasar yarn and denier have been evaluated. The observations further reveal that the rearing performances of all the three mutant strains as well as the control have been found to be better during the commercial crop season than the seed crop season.

Keywords: E.R.R., Cocoon weight, Shell weight, Shell Ratio, Filament length, Denier.

Introduction

The worldwide demand for silk is increasing but production is decreasing and an opportunity exists for India to use technical expertise to develop our own useful silk industry. India environmental conditions are very suitable for the development of sericulture, which includes both silkworm rearing and host pants cultivation for silkworm food. Which are widespread in India but little development work has been undertaken on these resources until the present. The first step in development is to identify the most productive strains of silkworm and their host plants. The second step is to decrease the risk of disease affecting production the third step is to increase production. In the case of Tasar silk production this latter aim is multifaceted and involves finding the best conditions under which to grow Tasar host plants in the most efficient and economical way to harvest the cocoons. The geo-climatic conditions play important role in productivity and quality of silk warm. In many countries sericulture is

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a sideline industry that offers a means for people to increase their incomes especially where prices for rural products are low. It is possible for this to occur in India but it is also possible that a highly sophisticated Sericultural industry would be viable.

Review Of Literature

Some notable investigations in relation to fecundity and fertility among sericigenous insects have been carried out by Ashan, et al. (1975), Chaudhary (1962), Jolly (1974) and Pandey (1989).It is reported that the sericigenous insects by and large prefer dark condition for the egg laying. The relative differences in the egg laying pattern among the different ecotypes have been reported by Sharma (1990). The relationship between the egg laying and the weight of the female pupae has been also worked out by Ahsan (1975). Jolly (1974) has reported that the rate of egg laying among the sericigenous insect, show a decrease from 1st to fifth days of egg laying. The effects of different diseases on the egg laying behaviour among Antheraea species have been carried out by Jolly et al. (1975).

The relative variations in relation to hatching behaviour among Antheraea species have been carried out by Ahsan, et al. (1975) and Sinha, et al. (1976). The effects of different temperatures in relation to egg laying and hatching have been carried out by Singh et al. (1990). The effects of different photoperiodic treatments on the hatching behaviour among the non-mulberry insects have been also carried out by Choudhary (1962). It is reported that a constant incubation of eggs at 30°C is useful and effective for the uniform hatching. Ahsan, et al. (1975) has also reported that the eggs of 1st and second days laid by the Tasar insect have greater rate of hatchability in comparison to latter days of eggs laid by Tasar female moth. However, fertility in silk moth depends largely on the ability of its male moth Siddhu et al. (1967). Univoltine and bi-voltine races of silk moths of B. mori were found to be much better in respect of larval development, pupal weight and egg laying, as compared to multivoltine strains of this species (B. mori). Sidhu and Khan (1969) found the breeds with multivoltine strain having higher fecundity.

In addition to all these some significant relationship had been observed between the fecundity and other parameters in the life of insects. Matui (1933) for instance studied functional inter relationship in copulation, fertilization and oviposition in Bombyx-mori. Robertson (1957) in his studies, on quantitative inheritance in Drosophila melanogaster had shown positive correlation between body size and egg production. Sidhu, et al. (1967, 1969) also correlated the size of pupae and moth with the number of eggs laid by female. They further studied egg production in two strains of Drosophila melanogaster and found oviposition behaviour related to age as well as other factors including quantitatical ones.

Henneberry and Krishna (1966), In cabbage looper Tichoplusla and Zecevic (1976). In Lymantriadispar found that pupal weight was positively correlated with development, egg masses and mating capability. Krishnaswamy et al. (1978) have reported that fecundity of female silk moth was closely linked with initial pupal weight. Samachary et al. (1980) have reported to have worked out some useful correlation between cocoon and shell weight and total weight of eggs expected to be produced by female silk moth. They have worked out formulae to assess the quantity of silk worm eggs expected to be produced. Thomas et al. (1982) found pupal weight as best estimator of number of mature eggs in Antheraea polyphemus Mukherjee, et al. (1983) established a correlation between the pupal weight and fecundity of Bombyx mori and found that female with higher pupal weight laid more number of eggs. Sharma et al. (1993) while working on the breeding behaviour of sericigenous insects found that variation in the breeding manifestations of silk insects are by and large influenced by the genetic factors and environmental fluctuations. The ecoraces, ecotypes and different strains of the sericigenous insects in spite of having the same chromosomal number present evident variations in their morphological and physio-genetic make-up (Kumar, etal, 2001).

Sharma et al. (1989) while working on the reeling behaviour of Tasar silk insects have noticed evident variations in respect of physical and technological characters of Tasar cocoons in relation to different factors. Further, Sharma et al. (1990) have reported variation in the quality of Tasar cocoons of different ecotypes of Antheraea mylitta under Indoor condition and claims the said variations owing to genetic changes. The variations in the diapausing behaviour of different ecotypes of Antheraea mylitta in relation to genetic and environmental factors have been carried out by Singh, et al. (1990), Sharma, et al. (1991) and Kumar, et al. (1991).

A comparative study on the diapausing behaviour of different mutant strains of Anthreaea mylitta has been carried out by Kumari, et al. (1992). The effects of genetic factors on the biochemical variations among the silk insects have been reported by Anand and Sharma (1992), Verma, Sharma and Anand (1993), Verma, Singh and Sharma (1991), Singh, et al. (1990), and Sharma and Kumar (1993). The rearing performances of mutant strains of Antheraea mylitta under laboratory conditions have been investigated by Anand, Mamta and

Sharma (1993). Kumar (2001) has reported variation in the sericin contents among the species of Antheraea under genetic variability's. Kumari (2003) while working on the biological manifestations of Antheraea proylei has reported the role of environmental factors on the biochemical and genetic changes under different conditions. Kumar, Saurabh (2003) has worked out on the behavioural and biochemical manifestations of the mutant strains of indigenous Tasar silk worm. Kumar, Manish (2005) has investigated the ethology of silk moths in relation to different factors Kumar, Dharmendra (2007) has reported that relative impacts of dietary variation on the biology of mutant strains of Tasar silk worm. The relative impact of different pathogens causing the diseases among the mutant strains and ecotypes of Antheraea mylitta has been worked out by Kumar, Nalin (2007). The variation in the biochemical contents of mutant strains and ecoraces in relation to extrinsic factors has been investigated by Pandey (2003). The relative impact of ecotypes of Antheraea mylitta has been investigated by Rani (2002). The relative impacts of selection on the genetic characters of Tasar silk worm has been worked out by Ranjan and Ram (2003).

Material and Methods

The disease free nature grown and inbred cocoon of three mutant strains viz; Am-yellow, Am-blue and Am-almond along with normal Am-green were collected from the seed supply centre Chaibasa (Jharkhand) and also from the field Laboratory, Nagri (Ranchi). The collected cocoons were put under normal Laboratory condition for proper acclimatisation for a week and thereafter, assorted and analysed as per the method suggested by Krishnaswamy (1973). The entire grainage operations were carried out during seed crop (July-Aug) and commercial crop (Sep-Oct) season, as per the methods suggested by Jolly et al. (1983). The method involves proper examination of coupled female moth after egg layings in respect of various infections. After egg layings, the eggs were washed in 2% formalin solution and soaked with filter papers. The eggs were then incubated at 30°c till hatching of the first in tastar larvae. The newly hatched larvae were transferred to Gamala grown Terminalia-arjuna plants and were reared under Laboratory condition as per the new technique of Laboratory culture suggested by Pandey (1989). The Laboratory cultures of different mutant strains with their control were carried out for both the seasons and presented in the tables. The following specific methods were used separately for each set of the experiment. Experiments were carried out in the P.G. Dept. of Zoology, Magadh University, Bodh-Gaya.

Five laying of three mutant strains namely Am-yellow, Am-blue and Am-almond along with normal Am-green (control) were prepared as per the method suggested. The laying of first day of different mutant strains and their control were considered for the experiment. The eggs were carefully washed in 2% formalin solution and incubated at 30°C temperature till hatching. Three different lots of freshly hatched larvae of mutant strains and one lots of freshly hatched larvae of control were brushed separately on Gamala grown Terminalia arjuna plants under Laboratory condition. Each lot consisting of 250 larvae were divided into five (50x5) replication. The rearing of different tasar larvae were carried out till cocoon formation during seed crop and commercial crop seasons.

The data in respect of E.E.R. (effective rate of rearing), cocoon weight, shell-weight and shell ratio were recorded carefully for each set of mutant strains and control. The data were further statistically analysed, correlated and finally presented in the table 1 to 8.

OBSERVATION

The relative rearing performances of three mutant strains of A. mylitta viz; Am-yellow, Am-blue and Am-almond along with the control (Am-Green) during the seed crop season in respect of percentage of E.R.R., cocoon weight, shell weight, shell ratio, filament length of tasar yarn and denier have been evaluated and the results so obtained have been presented in the tables 1 to 4

Table:-1 Showing rearing performances of Am-yellow mutant strain of Antheraea mylitta during the seed crop season under outdoor condition.

Sl. No.	Replications	ERR.(%)	Cocoon Wt. (gm)	Shell Wt. (gm)	Shell ratio (%)	Filament length (Mtr.)	Denier (D)
1	50	28	11.76	1.35	10.86	6525	1.5
2	50	27	11.78	1.36	10.86	6528	1.8
3	50	27	11.74	1.38	10.83	6527	1.8
4	50	28	11.73	1.36	10.84	6526	1.7
5	50	30	11.75	1.35	10.86	6525	1.8
Average	50	28	11.75	1.36	10.85	6526	1.7
CONTROL	50	34 **	11.82 *	1.43 *	10.98 *	6841 *	2.0 *

E. R. R. . = Effective rate of rearing

* = Significant

** = Highly Significant

Table 2

Table:-2 showing rearing performances of Am-blue mutant strain of Antheraea mylitta during the seed crop season under outdoor condition.

Sl. No.	Replications	E.R.R. (%)	Cocoon Wt. (gm)	Shell Wt. (gm)	Shell ratio (%)	Filament length (Mtr.)	Denier (D)
1	50	24	11.12	1.29	10.28	6432	1.5
2	50	23	11.13	1.25	10.27	6429	1.6
3	50	24	11.10	1.30	10.30	6430	1.3
4	50	25	11.13	1.28	10.31	6432	1.6
5	50	23	11.14	1.27	10.30	6432	1.5
Average	50	23.8	11.12	1.27	10.29	6431	1.5
Control	50	34 **	11.82 **	1.43 **	10.98	6841 **	2.0 *

E. R. R. . = Effective rate of rearing

* = Significant

** = Highly Significant

Table - 3

Table: 3 showing rearing performances of Am-almond mutant strain of Antheraea mylitta during the seed crop season under outdoor condition.

Sl. No.	Replications	E.R.R. (%)	Cocoon Wt. (gm)	Shell Wt. (gm)	Shell ratio (%)	Filament length (Mtr.)	Denier (D)
1	50	22	10.32	1.25	10.22	6390	1.3
2	50	21	10.34	1.26	10.21	6389	1.4
3	50	22	10.31	1.24	10.23	6387	1.2
4	50	20	10.34	1.26	10.23	6387	1.3
5	50	23	10.32	1.25	10.21	6388	1.3
Average	50	21.6	10.32	1.25	10.22	6388	1.3
Control	50	34 **	11.82 **	1.43 **	10.98 *	6841 **	2.0 **

E. R. R. . = Effective rate of rearing

* = Significant

** = Highly Significant

Table:-4

Table: Showing rearing performances of three mutant strain of Antheraea mylitta during the crop season under outdoor condition.

Sr. No.	Characters	Mutant Strains			Control	C.D. at .5% level for characters
		Daba Yellow	Daba blue	Daba almond		
1	E.R.R. (%)	28.0	23.8	21.6	34.0	**
2	Cocoon wt. (gm)	11.75	11.12	10.32	11.82	*
3	Shell wt. (gm)	1.36	1.27	1.25	1.43	*
4	Shell Ratio (gm)	10.85	10.29	10.22	10.98	*
5	Filament length (mtr)	6526	6431	6388	6841	**
6	Denier	1.7	1.5	1.3	2	*

ANOVA: Two factor without replication

Sources of Variation	S S	Df	M S	F
Rows	59.847516	3	19.935831	1.402848 *
Columns	5893.12187	4	1472.003000	103.856100 **
Error	171.85517	12	14.331268	-
Total	6123.815855	19		-

E.R.R. . = Effective rate of rearing

* = Significant

** = Highly Significant

Table - 1 accounts for the rearing performances of Am- yellow under the outdoor condition during the seed crop season. It indicates that the percentage of E.R.R. (28:34), cocoon weight (1:75:11.82 gms.) shell weight (1.36:1.43 gms), shell ratio (10.85:10.98%), filament length (6526: 6841 mtrs) and Denier (1.7:2D) of Am-yellow mutant strain are evidently inferior than its control. The percentage of E.R.R. (productivity) and filament length between the experimental lot and control lot are highly significant. A part from this cocoon weight, shell weight, shell ratio and denier of the yarn when compared with the control have been also found to be significant.

Table 2 accounts for the rearing performances of Am-blue mutant strain of Antheraea mylitta under the outdoor condition during the seed crop season. Table reveals that the percentage of E.R.R. (23.8:34), cocoon weight (11.12: 11.82 gms), shell weight (1.27: 1.43), shell ratio (10.29: 10.98%), filament length (6431 : 6841 mtr.) and denier (1.5D: 2.0D) between the mutant strain and the control present significant variation in respect of economic of tasar. It is very clear that the rearing performances of Am-blue are inferior than the control under the outdoor condition of rearing.

Likewise table 3 reveals the rearing performances of Am-almond mutant strain of Antheraea mylitta under outdoor condition during the seed crop season. Table shows that the percentage of E.R.R. (21.6: 34.0), cocoon weight (10.32 : 11.82 gms), shell weight (1.25: 1.43 gms), shell ratio (10.22: 10.98%), filament length (6388: 6841 mtr.) and Denier (1.3D: 2.0D) between the mutant strain and its control are significant and present evident variation in respect of economic characters under the outdoor condition of rearing. It is evident that the rearing performances of Am-almond like two others mutant strains are inferior than the control.

Table 4 accounts for the relative rearing performances of all the three mutant strains of Antheraea mylitta under outdoor condition during the seed crop season. Table reveals that the E.R.R. percentage (28.0, 23.8 and 21.6), cocoon weight (11.75 gm, 11.12 gm, and 10.32 gm), shell weight (1.36 gm, 1.27 gm and 1.25 gm) shell ratio (10.85%, 10.29% and 10.22%) filament length (6526 mtr, 6431 mtr and 6388 mtr) and Denier (1.7D, 1.5D and 1.3D) of Am-yellow, Am-blue and Am-almond mutant strains present significant variation among themselves and are inferior than the control under the outdoor condition during seed crop season. The percentage of E.R.R. (34.0), cocoon weight (11.82 gm), shell weight (1.43 gm), shell ratio (10.98%), filament length (6841 mtr.) and Denier (2D) of control (Am-Green) are evidently superior to the three mutant strains under the outdoor condition.

ANOVA of the tables as sources of variations in Rows ss (59.847516), df (3), MS (19.935831 and F (1.402848) in columns - ss (5893.12187), df (4), MS (1472.003000) and F (103.856100) clearly account for the significant variations in respect of quantitative and qualitative characters of mutant strains under the outdoor condition of rearing during the seed crop season. Further the rearing performances of all the three mutant strains of A. mylitta along with the control during the commercial crop season under the outdoor condition have been evaluated and the results so obtained are recorded in the tables 5 to 8.

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Table - 5

Table: Showing rearing performances of Am-yellow mutant strain of Antheraea mylitta during the commercial crop season under outdoor condition.

Sl. No.	Replications	E.R.R. (%)	Cocoon Wt. (gm)	Shell Wt. (gm)	Shell ratio (%)	Filament length (mtr.)	Denier (D)
1	50	29	11.81	1.40	10.92	6541	2.1
2	50	30	11.82	1.40	10.93	6545	2.2
3	50	30	11.80	1.38	10.94	6547	2.0
4	50	29	11.83	1.39	10.93	6545	2.1
5	50	28	11.82	1.38	10.92	6547	2.1
Average	50	29.2	11.82	1.39	10.93	6545	2.1
Control	50	35	11.91	1.52	11.12	6893	2.3

E.R.R. . = Effective rate of rearing, * = Significant ** = Highly Significant

Table - 6

Table: Showing rearing performances of Am-blue mutant strain of Antheraea mylitta during the commercial crop season under outdoor condition.

Sl. No.	Replications	E.R.R. (%)	Cocoon Wt. (gm)	Shell Wt. (gm)	Shell ratio (%)	Filament length (mtr.)	Denier (D)
1	50	25.0	11.15	1.32	10.30	6510	1.8
2	50	26.0	11.16	1.31	10.31	6513	1.9
3	50	24.0	11.17	1.32	10.32	6514	1.9
4	50	25.0	11.16	1.30	10.30	6516	1.8
5	50	25.0	11.16	1.31	10.31	6516	1.1
Average	50	25.0	11.16	1.31	10.31	6513	1.9
Control	50	35.0	11.91	1.52	11.12	6893	2.3

E.R.R. . = Effective rate of rearing
* = Significant
** = Highly Significant

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Table-7: Showing rearing performances of Am-almond mutant strain of Antheraea mylitta during the commercial crop season under outdoor condition.

Sl. No.	Replications	E.R.R.(%)	Cocoon Wt. (gm)	Shell Wt. (gm)	Shell ratio (%)	Filament length (mtr.)	Denier (D)
1	50	24.0	10.34	1.27	10.23	6492	1.9
2	50	23.0	10.33	1.28	10.24	6495	1.8
3	50	24.0	10.35	1.29	10.25	6491	1.7
4	50	25.0	10.32	1.28	10.26	6490	1.8
5	50	24.0	10.36	1.28	10.27	6492	1.8
Average	50	24.0	10.35	1.28	10.25	6493	1.8
CONTROL	50	35.0	11.91	1.52	11.12	6893	2.3

E. R. R. . = Effective rate of rearing
* = Significant
** = Highly Significant

Table-8: Showing rearing performances of three mutant strain of Antheraea mylitta during the commercial crop season under outdoor condition.

Sr. No.	Characters	Mutant Strains			Control	C.D. at .5% level for characters
		Daba Yellow	Daba blue	Daba almond		
1	E.R.R. (%)	29.2	25.0	24.0	35.0	**
2	Cocoon wt. (gm)	11.82	11.16	10.35	11.91	*
3	Shell wt. (gm)	1.39	1.31	1.28	1.52	*
4	Shell Ratio (gm)	10.93	10.31	10.25	11.12	*
5	Filament length (mtr)	6545	6513	6493	6893	**
6	Denier	2.1	1.9	1.8	2.3	NS

ANOVA: Two factor without replication

Sources of Variation	S S	Df	M S	F
Rows	58.398472	3	19.43321	1.465302
Columns	5988.46339	4	1499.863000	113.149302
Error	161.49712	12		
Total	6219.330857			

E.R.R. . = Effective rate of rearing
* = Significant
** = Highly Significant

Table 5 reveals the rearing performances of Am-yellow in respect of percentage of E.R.R. (29.2), cocoon weight (11.82 gm), shell weight (1.39 gm), shell ratio (10.93%), filament length (6545 mtr.) and Denier (2.1D) during the commercial crop season under the outdoor condition.

Table 6 accounts for the rearing performances of Am-blue in respect of percentage of E.R.R. (25.0), cocoon weight (11.16 gm), shell weight (1.31 gm), shell ratio (10.31%) filament length (6513 mtr.) and Denier (1.9D) during the commercial crop season under the outdoor condition.

Likewise table 7 reveals the rearing performances of Am- almond in respect of percentage of E.R.R. (24.0), cocoon weight (10.35 gm), shell weight (1.28 gm), shell ratio (10.25%), filament length (6493 mtr.) and Denier (1.8D) during the commercial crop season under the outdoor conditions.

The rearing performances of control (Am-Green) in respect of percentage of E.R.R. (35.0), cocoon weight (11.91 gm) shell weight (1.52 gm), shell ratio (11.12%), filament length (6893) and Denier (2.3D) during the commercial crop season under the outdoor have registered its supremacy over the three mutant strains.

Table 8 indicates the relative rearing performance of three mutant strains as compared to their control under the aforesaid conditions of rearing. It shows that percentage of E.R.R. (29.2, 25.0 and 24.0) cocoon weight (11.82, 11.16 and 10.35 gms), shell weight (1.39, 1.31 and 1.28 gms), shell ratio (10.93%, 10.31% and 10.25%), filament length (6545, 6513 and 6493 mtrs) and Denier (2.1D, 1.9D and 1.8D) present significant variations among themselves in respect of their rearing performances and are inferior than the control under outdoor rearing during the commercial crop season.

The ANOVA of the tables in respect of variations as Rows ss (58.398472), df (3), MS (19.433221) F (1.465302), columns ss (5988.46339), df (4) MS (1499.563000), F (113.149302), Error (161.49712), df (12) and total (6219.330857) clearly account for the evident variations among the mutant strains in respect of their rearing performances, during the commercial crop season in respect of rearing performances.

The overall observations thus account for the under given facts: Three mutant strains of Antheraea mylitta namely Am- yellow, Am-blue and Am-almond owing to their different genetic architecture differ among themselves in respect of their rearing performances during the seed crop and commercial crop seasons under the outdoor conditions.

Among all the three mutant strain the relative rearing performances of Am-yellow as compared to Am-blue and Am-almond are better during both the seasons. It follows the under given relative order in respect of their rearing manifestations under outdoor. Am-yellow< Am-blue < Am- almond

The relative rearing performances of all the three mutant strains of Antheraea mylitta in respect of percentage of E.R.R., cocoon weight, shell weight, shell ratio, filament length and Denier of the tasar yarn are evidently inferior than the control. It shows relatively poor tendency of acclimatisation of mutant strains under the outdoor conditions of rearing than the control. The commercial crop season is relatively better than the seed crop season in respect of rearing performances under outdoor conditions. Seasonal variations have been found to be significant. Among all the rearing characters, the percentage of E.R.R. and filament length of tasar yarn has been found relatively more significant during both the seasons.

Discussion

Results are indicative of the fact that all the three mutant strains of Antheraea mylitta have relatively inferior rearing performances than the control under the outdoor condition. The result so obtained may be made clear in the light of the fact that all the three mutant strains of Antheraea mylitta owing to their different physio-genetic makeup are facing difficulties to cope up with the environmental condition of the outdoor unlike the control. It is a question really related with the fitness of organism under the outdoor condition. It appears that the newly emerged mutant strains have not adjusted and acclimatized under the outdoor condition like their parent as a result these strains have shown relatively inferior rearing performances under the outdoor condition. The fitness, adjustment and acclimatization of the newly evolved organism are associated with the suitability of the environment for their desired biological manifestations. The concept is well supported by Dorwin, Haldane, Fisher and Wright. Therefore, it is logical to assume that the three mutants have not yet adjusted properly under the outdoor condition and they require desired conducive environment for better performances. The unsuitable and unfavourable existing environment appears to be the potent reason for the said results obtained. It probably requires shifting of environmental condition and search for the conductive environment for desired activities.

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