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Research Article

Relation Between Female Cocoons (pupae) Measurements and the Number of Eggs Laid (fecundity) by the Wild Silk Moth *Epiphora bauhiniae* (Gurin-meneville) Lepidopetera: Saturniidae.

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Abstract

This study was conducted in Gedarif state, Sudan during the season 2009-2010.The aim of the study was to determine correlation between the eggs laid by the female of E. bauhiniae and the weight, length and girth of the cocoons (pupae) that the insect emerged from them. Laboratory study was done using a cage specially constructed for the study with four rooms to allow insect to emerge and deposit her eggs separately. i.e. four replicates were used. Statistic analysis was used for data to determine the significant difference. The result showed that the numbers of eggs laid by the insect are significantly associated with weight, Length and girth of the female cocoons. The high values of the measurements (weight, length and girth) were achieved which showed greatest potential of female in term of egg Laid.
This result reflects the positive correlation between the measurements of cocoons and fecundity of the emerged insect. The findings will pave the way for more investigation on egg production of this wild silk moth, as this study reported to be the first study, concerning with eggs of E. bauhiniae in Sudan as undomesticated insect which underlining length, weight and girth of cocoons to be good indictor to estimate female's fecundity. The study concluded that, these factors should be looking after as important factors for any investment regarding egg production of E. bauhiniae, because this will be an augmentative for large scale investment of silk production in Sudan.

Key words: *fecundity, cocoons, eggs, Epiphora bauhiniae, silkworm.*

1. Introduction

All the true silkworms belong to the order *lepidoptera*. The famous super family of silkworm is *Bombycoidea*, under which the two families *Bombycidae* and *Lasiocampidae* are classified. *Bombyx mori* is a member of the family *Bombycidae* (S.M. Madras, 1982). However, saturniidae is the largest silkworm family. Members of this family are brightly coloured moths. The Larvae are large, characterized with spine tubercles and pupated in silken cocoons. The family saturniidae world wide has nine subfamilies, 165 genera, and 1480 species (M. Scoble, 1992).Under saturniidae family are the genera *Actias*, *Antheraea*, *Attacus*, *Philosamia* and *Saturnia* (S.M. Madras, 1982). Nevertheless, (B. A. Gashe, S. F. Mpuchane, 1996) added *Epiphora*, as an important genus to this family. Species under the genus *Antheraea* are known as Tasar silkworms and Japanese oak silkworms (R.K.Pandey, , R.k Goel., 1991) and (K.U.S. Rao *et al*, 2000). However, species under *Epiphora*, are known as Emperor moths. They are classified under the sub order Ditrysia and the family saturniidae (Billoelke, 1980) and (B. A. Gashe, S. F. Mpuchane, 1996). So far species under *Epiphora* is bauhiniae. The subject species *Epiphora bauhiniae* was found and known in South and Central Africa (Billoelke website, 2003**)**, and hosted on important fodder trees *Ziziphus* spp. The leaves are used for rearing tasar silkworm for commercial uses in tropical region (K. Vogt, 1987). The wild silk moth *E.bauhiniae* was found in Sudan and has a wide range of distribution. It was found in Gedarif, South Kassala, Sinnar, BlueNile, White Nile, Kordofan and Darfur produced a commercial silk fibers, easy to be discharged, this will pave the way for a good opportunity of silk industries in Sudan (M. A. Eltayb *et al*, 2008). Sericulture provides diversification weather practiced in forest areas, arable land or river banks. Sericulture is an industry of small-scale labor and this will create jobs in rural areas and cut down the movement towards big cities. The silk industry is divided into a number of separate enterprises one of these is egg production (H. H. Manchester, 1924). Silk eggs are of two types those used for reproduction (used as stock by egg producers) and those used by cocoon production (hatched by farmers for cocoon production) (Ikpai, 1997). Egg production is an important enterprise of silk industry from

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which the produced eggs delivered to cocoon producer farmers. Sericulture provides diversification which has a positive sign on the environment. As stated by (R. Tsiresy *et al*, 2006) the rural poor can drive a livelihood from protecting forests instead of cutting them down; where development planers understand that habitat health is the corner stone for human health and survival, and what where conservation biologist understand long term solutions to biodiversity loss must be built around social programs which enable people to survive.

There is a dearth of information on many aspects of sericulture in general and grainage activities such as synchronization of most emergence viable quality eggs in particular which are of paramount importance for timely supply of laying for successful sericulture practice. In mulberry sericulture the usual device for egg laying is a paper, sheet, nylon net bag are used for egg laying in *Antheraea pernyi* in china. Kharika is used for egg laying in sericulture as well as in Muga (N.G. Ojha *et al*, 1999). A small bamboo basket is quite convenient to prepare Eri silk worm laying (M.C. Devaian *et al*, 1981). The silk quality produced from multi voltine strain is at low level when compared to the existing international standards. China silk is superior quality as they are bivoltine strain (V.K. Ramathala, 2012) quantitative traits of silkworm reported by (D. Jamuna and G. Subramanya 2012) as larval weight , cocoon weight , shell weight, shell ratio, pupation rate and filament length , While (G.K. Fashid and H.B. Mahesha 2012) reported on the commercial characters of silkworm are fecundity ,larval weight , larval duration , single cocoon weight. single shell weight, shell ratio, filament length and denier .

E. bauhiniae has a good potential on rearing for silk production in Sudan. The life cycle is short (58 – 59.2 days) larval period range between 19 – 20 days, fecundity (160- 286 eggs). The species generates twice a year (bivoltine) (M. A. Eltayb *et al*, 2013). Sericulture is practice in India in more than 60.000 villages. Four types of silk which are of commercial exploited in India are mulberry, Tassar, Eri and Muga. India is a largest producer of Eri silk in the world 96% (K. Bajesh and S.K. Gangwar, 2010). Recent scanty information about *E. bauhiniae* silkworm is known as commercial insect (M. A. Eltayb *et al*, 2013) but no study reported about its potential in egg production which regard as a back bone for sericulture industry for this reason this study aimed to support sericulture in Sudan by identifies the best way or process to select the female cocoons from the patch so as to produce high quantity of eggs i.e. high fecundity females. The objective of the study is to test the hypothesis that the measurements (weight, length and girth) of the female cocoons of *E.bauhiniae* correlate with fecundity.

Materials and Methods

This study was conducted in the area of Gedarif State, eastern Sudan which lies between latitudes 12º 45º N, and 14º 15` N, longitudes 34º E and 37º E, (altitude 600m above sea level).

Climatic conditions of the study area:

The rainfall varies from north to south. The average annual rainfall in Gerba (143 km from Gedarif), is 175 mm to 570 mm at Galabat (150 km South Gedarif). It is markedly seasonal in character. The length of the rainy season fluctuates during July to October, and reaches peak in August. Records on relative humidity, and temperature during the study period were recorded.

Twenty healthy female cocoons of *E.bauhiniae* were collected from the culture of the recent patches in Gedarif town, Gedarif State, Eastern Sudan during season 2009.The cocoons were divided into four groups, five cocoons in each room i.e. four replicates were used. All cocoons of each rep. were weighed, singly labeled and data were recorded. Experimental cage was used which consist of wood, covered all side with wire mesh, divided it into four chambers, and each chamber divided into two rooms (emergence and laying room), each room had five cocoons. The cage had good ventilation and drainage, and it was placed outside the laboratory exposed to direct sunlight and rain fall during the rainy season 2009. Observation was done for emerged insects in the upper emergence rooms, and transferred to lower laying rooms that supplied by foliage of *Ziziphus spina christi* as deposited site for insects to lay her eggs during oviposition period. When the female laid complete depositing of eggs, then eggs were collected separately from deposited leaves, calculated and recoded after the death of the insect. Surgical operation was done for the dead insects and the numbers of eggs that remained inside abdomens (i.e. not have a chance to be laid) were recorded also for each female. Data were analyzed statistically by SPSS program to test correlation of variables (weight, length and girth) with fecundity used (2 tailed test).

Results and Discussions

The result showed that the number of eggs laid per female of the silkworm *E.bauhiniae* was correlated significantly with cocoon measurements (weight, length, and girth) (Table 1, 2) Cocoons (pupae) measurements were the best indicators of fecundity (plate 1 and 2). This result is in agreement of the result that reported by (S. Bad hera, 1992) in pupal measurements of *Antheraea mylitta*, he found that the pupal measurements (weight, abdominal length, and girth)was correlated with fecundity of the silkworm *Antheraea mylitta* and the weight was the best estimate of fecundity. This result is in line with (Ksubramanian *et al*, 2012) they found that the cocoon weight has significant positive correlation with fecundity and egg hatchability. The maximum weights of egg were laid by moths that emerged from maximum weighed cocoons, compared to those from minimum weighed cocoons. (Y.K. Kotikal *et al*, 1989) found the same results, where they reported that, fecundity of moths has significant positive correlation with cocoon weight, pupal weight, pupal length and the girth where were found to be genuine estimators of the fecundity, i.e. the pupal weight was the best estimator of the fecundity. In Tassar silkworm *Antherae myllita*, the number of eggs laid, could be attributed to the differences, in the female pupal weight

Table 1

Weight (g), Length (cm), girth (cm) and eggs laid (fecundity) per female of *E.bauhiniae*

Rep. Number	**Cocoons Number**	**Cocoon**			**Fecundity of female insect**		
		Weight(g)	**Length(cm)**	**Girth(cm)**	**Deposited eggs**	**Undeposited eggs**	**Total eggs**
1	1	1.2	3	2	202	2	204
	2	1.4	3	2.2	190	28	218
	3	1.6	3	2.3	233	0	233
	4	1.8	3.3	2.6	270	9	279
	5	1.7	3.3	2.4	243	7	250
Total		7.7	15.6	11.5	1138	46	1184
Mean		1.54	3.12	2.3	227.6	9.2	236.8
2	1	1.3	3	2.1	230	2	232
	2	1.4	3	2.1	222	15	237
	3	1.7	3	2.4	245	5	245
	4	1.9	3.4	2.6	270	9	279
	5	2	3.4	2.7	280	8	288
Total		8.3	15.8	11.9	1242	39	1281
Mean		1.66	3.16	2.38	248.4	7.8	256.2
3	1	1.5	3	2.3	220	5	225
	2	1.5	3	2.3	210	13	223
	3	1.2	3	2	192	6	198
	4	1.8	3.3	2	280	3	283
	5	1.8	3.3	2.6	281	0	281
Total		7.8	15.6	11.2	1183	27	1210
Mean		1.56	3.12	2.24	236.6	5.04	242
4	1	1.8	3.2	2.6	280	0	280
	2	2	4.4	2.6	273	10	283
	3	1.6	3.2	2.4	233	7	240
	4	1.9	3.4	2.5	281	0	281
	5	1.8	3.2	2.5	272	7	279
Total		9.1	16.4	12.6	1339	24	1363
Mean		1.82	3.28	2.25	267.8	4.8	272.6

Table 2

Correlation between fecundity of insect and weight, length and girth of female cocoons (pupae)

Variable	Mean	Standard Dev.	Pr.	correlation	Sig. (2tailed)
WEIGHT	1.645	0.2502	0	0.938	0
LENGTH	3.22	0.3205	0.003	0.63	0.003
GIRTH	2.36	0.2303	0	0.748	0

Correlation is significant at the 0.01 level (2 tailed

(A. M. Ashan and Khanna, 1976) (A. T. Miller *et al*, 1982) reported that the weight of female pupae, to be the best character to estimate, the number of eggs in *A. polyphermus.*

These results are in conformity with our results where the fecundity of female *E. bauhini*'s cocoon weight, length and size were positively, correlated with its fecundity. This preliminary study report is useful to *E.bauhiniae* culture to developing its crop, because this wild insect has high potential, for egg production, quantitative and qualitative traits as stated by (M. A. Eltayb *et al*, 2013) and other researchers like (M.C. Devian *et al*, 1981), (D. Jamuna and G. Subramanya, 2012) and (G.K. Fashid and H.B. Mahesha, 2012) on commercial characters of silk worm races.

Conclusions and Recommendations

From the result of this study the cocoons of *E.bauhiniae* that selected from the patch to be reared for eggs production. The objective aimed to determine the correlation between the fecundity of emerged female insect and the cocoon that have emerged from it. The result indicates the positive correlation between fecundity and studied factors (weight, length & girth) i.e. the highest measurements of female cocoons, the highest eggs expectancy of to be laid by female.

This result will encourage sericulture industry in Sudan and consequently contributing in poverty alleviation. Sharing of research and market information with other countries is essential for the production of high quality of silk worm eggs, disease resisting with high production. Establishment of storing and cooling egg's center in silk rearing areas is considered necessary. Forestry extension should play a good role in raising awareness to promote communities and private sectors to invest in sericulture in Sudan.

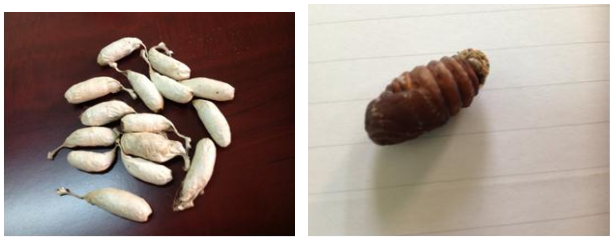

Plate (1): Cocoons (left) and pupae of *E.bauhiniae* (right)

Plate (2): Adult insect (left) and eggs of *E.bauhiniae* (right)

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