

EFFECTS OF EXSITU PRESERVATION OF SEED COCOONS OF REPRODUCTIVE BEHAVIOUR OF LARIA ECORACE, *ANTHRAEA MYLITTA* DRURY A TROPICAL TASAR SILKWORM IN NORTH CHHATTISGARH

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ABSTRACT:- Tropical tasar silkworm, *Antheraea mylitta* produces tasar silk having vast demand in national and international market due to unique quality. Seed cocoons of *Laria ecorace* *Antheraea mylitta*, Drury harvested during second crop rearing (November) undergo diapause in pupal stage. It resume lifecycle only with the onset of monsoon in June and survive better subjected to the availability of congenial atmosphere and abundant foliage on host plants. During prolonged preservation of *Laria ecorace* seed cocoons for 6-8 months, cocoon lot suffered losses in terms of unseasonal moth emergence, abnormal moth emerge, pupal mortality, (Dead cocoons), infestation of zizyfly and yellow (Ichneumon) fly, pairing of moths and rodent damage cocoons. The present investigations were undertaken in mud walled (Exsitu) grainage house with an aim to find out suitable grainage technique commercialization of *Laria ecorace*, *A.mylitta* D. results revealed that unseasonal moth emergence and subsequent pairing were observed as 26.76 to 38.66% and 35.50 to 37.00% respectively during November to February. Pupal mortality was recorded in the range of 4.50 to 11.50% with a mean of 8.50% mortality. Total cocoon preservation loss was recorded as 41.36 and 45.07% during 2018 and 2019 years of seed cocoon preservation. Hence, the mud walled (Exsitu) grainage house with slight modifications in micro climate are useful for seed cocoon preservation under prolonged Pupal diapause of *Laria ecorace*, *A.mylitta* D.

KEYWORDS: *Laria ecorace*, *Antheraea mylitta* preservation loss, pupal mortality.

INTRODUCTION:-

Most stabilized ecorace of tropical tasar silkworm, *Antheraea mylitta* Drury are the most preferred for production of silk cocoons at commercial level. Based

on the suitable climatic conditions, tasar silkworm has one (univoltine) or two (bivoltine) or three (trivoltine) crop cycles in a year. First and second crop of trivoltine and first crop cycle of bivoltine races during June to August are termed as seed cocoon crops. The second and third crop cycles during September to December are known as commercial crops (Jolly et al 1979, Chakravorty et al 2004 and Singh et al 2014). *Laria ecorace*, *A. mylitta* D. pupae mostly have undergone diapausing stage in cocoons harvested during IInd crop rearing (mid-August to mid-October) and IIIrd crop (mid November to January) rearing seasons for the durations of 6-7 months and 5-6 months, respectively. This kind of pupal diapause of *Laria ecorace* in North Chhattisgarh clearly indicates the obligatory type of diapause. Moth emergence was observed erratically during pupal diapause based on the fluctuations in temperature and humidity inside the grainage houses prevailed. However, regular moth emergence was occurred from the diapausing (pupal) cocoons synchronizes with the onset of monsoon showers happened in the last fortnight of June or first week of July of study years. In holometabolus insects i.e., silkworm complete metamorphosis of pupa into adult moth usually have taken place within the silken cocoon which lasted for 6 to 7 days in grainage houses. It is very noteworthy to mention that adult moth population emerged throughout the year from the *Laria ecorace* cocoons preserved during the grainage. The regular and peak period of moth emergence was mostly noticed during July and September and upto some extent in December month. Studies on assessment of preservation loss of *Laria ecorace* *A.mylitta* cocoons under pupal diapause

with an aim to know the percent loss due to unseasonal moth emergence, pairing, pupal mortality, infestation of yellow, uzifly and rodent attack in the preserved cocoons under mudwalled grainage house.

MATERIALS AND METHODS:-

Cocoons of *Laria ecorace*, *A. mylitta* harvested from natural forest and own rearing during IInd crop rearing season under *Exsitu* conditions were preserved under

pupal diapause from November to June month of next year. Seed cocoons kept for Ist crop grainage in mud walled grainage (*Exsitu*) house were sorted out periodically to ascertain preservation loss under prolonged (6-8 months) pupal diapause in terms of number unseasonal moth emergence (pierced cocoons), dead cocoons (pupal/mortality), uzifly and yellow fly infested cocoons and rat out cocoons.

Table: 1 - Preservation loss of *Laria*, *A. mylitta* seed cocoons kept under pupal diapause for Ist crop grainage-2018 (cocoons preserved-3150)

Seed Cocoon Kept	Period	Unseasonal moth emergence			Pairing	No. of dead pupae	Uzifly infested cocoons	Yellow fly infested cocoons	Rat cut cocoons	Total cocoon loss	No. of good cocoons	
		Male	Female	Total								
1	2	3	4	5	6	7	8	9	10	11	12	
MUDWALLED GRAINAGE HOUSE (EX-SITU)	1st to 15th November'2017	0	0	0	0	0	0	0	0	0	3150	
	16th to 30th November'2017	157	139	296	60	0	0	2	0	298	2852	
	1st to 15th December'2017	144	161	305	97	0	0	30	0	335	2517	
	16th to 31st December'2017	54	7	61	0	0	0	39	0	100	2417	
	1st to 15th January'2018	42	6	48	0	0	0	0	0	48	2369	
	16th to 31st January'2018	29	2	31	0	0	0	0	0	31	2338	
	1st to 15th February'2018	47	0	47	0	0	0	0	3	50	2288	
	16th to 28th February'2018	29	0	29	0	0	0	0	0	29	2259	
	1st to 15th March'2018	10	0	10	0	17	0	0	0	27	2232	
	16th to 31st March'2018	7	0	7	0	16	0	0	1	24	2208	
	1st to 15th April'2018	0	0	0	0	33	0	0	0	33	2175	
	16th to 30th April'2018	0	0	0	0	66	0	0	8	74	2101	
	1st to 15th May'2018	0	0	0	0	145	0	0	0	145	1956	
	16th to 31st May'2018	0	0	0	0	85	0	0	15	100	1856	
	1st to 15th June'2018	5	4	9	0	0	0	0	0	9	1847	
	Total		524	319	843	157	362	0	71	27	1303	1847
	percent		(16.63%)	(10.12%)	(26.76%)	(37.24%)	(11.50)	(0%)	(2.25%)	(0.85%)	(41.36%)	(58.36%)
	Mean		34.93	21.27	56.20	10.47	24.13	0.00	4.73	1.80	86.87	123.13
Min.		0	0	0	0	0	0	0	0	0	1847	
Max.		157	161	305	97	145	0	39	15	335	3150	

Table No. 2- Preservation loss of Laria, A. mylitta seed cocoons kept under pupal diapause during Ist crop grainage-2019 (cocoons preserved-3150)

Seed Cocoon Kept	Period	Unseasonal moth emergence			Pairing	No. of dead pupae	Uzifly Infested Cocoon	Yellow fly infested cocoons	Rat cut cocoons	Total cocoon loss	No. of good cocoons	
		Male	Female	Total								
1	2	3	4	5	6	7	8	9	10	11	12	
MUDWALLED GRAINAGE HOUSE (EX-SITU)	1st to 15th November'2018	0	0	0	0	0	0	0	0	0	3150	
	16th to 30th November'2018	96	76	172	23	0	0	16	5	193	2957	
	1st to 15th December'2018	544	388	932	236	0	0	17	0	949	2008	
	16th to 31st December'2018	44	5	49	0	0	0	0	0	49	1959	
	1st to 15th January'2019	13	8	21	2	0	0	0	5	26	1933	
	16th to 31st January'2019	6	3	9	0	0	0	0	4	13	1920	
	1st to 15th February'2019	2	2	4	0	0	0	0	0	4	1916	
	16th to 28th February'2019	0	0	0	0	0	0	0	0	0	1916	
	1st to 15th March'2019	0	0	0	0	0	0	0	13	13	1903	
	16th to 31st March'2019	6	1	7	0	0	0	0	0	7	1896	
	1st to 15th April'2019	8	7	15	0	0	0	0	0	15	1881	
	16th to 30th April'2019	0	0	0	0	0	0	0	0	0	1881	
	1st to 15th May'2019	0	0	0	0	37	0	0	0	37	1844	
	16th to 31st May'2019	0	0	0	0	105	0	0	0	105	1739	
	1st to 15th June'2019	6	3	9	2	0	0	0	0	9	1730	
	Total		725	493	1218	263	142	0	33	27	1420	1730
	percent		23.00%	15.65%	38.67%	8.35%	4.50%	0.00%	1.04%	0.85%		54.92%
	Mean		48.33	32.87	81.20	17.53	9.47	0.00	2.20	1.80	94.67	115.33
Min.		0	0	0	0	0	0	0	0	0	1730	
Max.		544	388	932	236	105	0	17	13	949	3150	

MUDWALLED GRAINAGE HOUSE:-

A well ventilated rat proof, mud walled house (20' x 15' x 12') with 5' wide verandah and thatched roofing was selected at Ambikapur for conducting grainage operation

by making own arrangements to study the reproductive behaviour under *Exsitu* (captive) conditions. The mud walled grainage was surrounded by trees and green vegetation to create optimum conditions viz., Temperature 26oC - 28oC and Relative 3 Humidity 45-60% for seed cocoon preservation under pupal diapause. The central hall was utilized to accommodate

3150 Laria seed cocoons in garlands in hanging position and provided scope for moth emergence and mating naturally. Laria seed cocoons were preserved in 09 replications i.e. 350 cocoons per replication with a total of 3150 seed cocoons garlanded at the rate of 100 cocoons per garland during 2018 and 2019.

RESULTS AND DISCUSSION:-

Unseasonal moth emergence (Erratic emergence) :

Results on male and female moths emerged erratically from the seed cocoons preserved for Ist crop grainage of 2018 and 2019 in mud walled grainage (*Exsitu*) house

revealed that unseasonal moth emergence pattern was much higher (843, 26.76% and 1218, 38.66%). The peak period of moth emergence was observed from 2nd fortnight of November to second fortnight of February in mud walled.

Pairing

The male and female moths emerged during cocoon preservation under pupal diapause paired successfully in *Exsitu* grainage house. Pairing percentage was recorded as 37.00% ; 157 and 35.50%;162 during preservation period 2018 and 2019 in mudwalled grainage house. Climatic conditions inside mud walled grainage house i.e., temperature (12.7°C-26.3°C mean 16.7°C) and optimum Relative humidity (44.00-78.60% mean 67.40%) were recorded and those might have favoured for peak unseasonal moth emergence during November-February months of 2017-18 and 2018-2019. High temperature (23.00-36°C mean 33°C) and low humidity (31.50-43.00% mean 43.00%) might be the reason behind the low moth emergence erratically during prolonged preservation of seed cocoons under pupal diapause. It is very pertinent to note that, the peak and subsequent low moth emergence was recorded very low in contrast to mud walled grainage house. The unseasonal emergence (erratic) of moths is not a good sign for egg production of *Laricia ecorace* in first crop grainage. The above findings are in conformity with those of Singh *et al* (2004) and Kumar *et al* (2012) who have reported that near to optimum temperature and Relative humidity were prevailed in concrete (*Exsitu*) house conditions. Singh *et al* (2020) reported that optimum favourable climatic conditions for *A. frithii* wild oak tasar silk moth to emerge and coupling are 22-24°C, 75-85% R.H. Around 45-60% pairing occurs under captive conditions.

Pupal mortality (No. of dead pupae) :-

Pupal mortality was evaluated much higher (142-362 & 4.50% - 11.50%) in mud walled grainage houses. Singh *et al* (2014) inferred that summer seed cocoon preservation under pupal diapause may lead to pupal mortality under extreme weather conditions i.e., high temperature (35°-40°C) and low humidity (30-40%). Pupal mortality and erratic moth emergence under the influence of adverse climatic conditions are also posing a great threat to tasar industry. On the other hand the abiotic factors are dictating the behaviour of the stock of the *A. mylitta* ecoraces in grainages.

Uzifly infested cocoons: Tasar uzifly, *Blepharipa zebina* (Diptera : Tachinidae) is the key parasite of *A. mylitta* D. Female uzifly lays 15-20 eggs on the inter segmental body region of the silkworm matured larva. The infested worms are recognised with the presence of black spot on the larvae. The newly hatched maggots of uzifly enters into the host body and undergoes 03 instars with 15-20 days by devouring inner contents rapidly. The mature maggot wriggles out by piercing the larval or pupal body of host by killing the host instantly (Singh *et al* 2014; Jolly *et al* 1979) and Thangavelu *et al* (1988). It very interesting to note that no infestation of uzifly *B. zebina* was observed on the final and Vth instar larva of *Laricia ecorace* during study period in this area.

Yellow fly infested cocoons:

Ichneumon fly, *Xanthopimpla* pedator (*Ichneumonidae*; *Hymenoptera*) popularly known as yellow fly among tasar farmers community. The female parasitoid search for spinning tasar silkworm larva with the help of its antennae and lay single egg. The adult fly emerges from pupa formed by piercing cocoon in the anterior end near the peduncle causing the lose to reeling parameter. The larva of fly feeds on inside the pupa of *A. mylitta* and develops into adult fly (Singh *et al* 2014). The killing of pupae by endoparasitisation by yellow fly was more at the time of cocoon formation during IInd crop of *Laricia ecorace* under *Exsitu*.

Rat cut cocoons : The cocoons of *Laricia ecorace* preserved under *Exsitu* were equally damaged by rodents with no distinct variation in attack.

Total cocoon loss (preservation loss) :

The total cocoons loss (%) was estimated after summing up all the losses of all parameters, except pairing of moths, as 1303 (41.36%) - 1420 (45.07%) (in mudwalled grainage)houses, The results indicated that mudwalled grainage (*Exsitu*) houses are useful for seed cocoon preservation under prolonged pupal diapause of *Laricia ecorace*, *A. mylitta*.

The present findings on preservation loss of seed cocoons preserved in *Exsitu* grainage houses are in close confirmity with those Chakravorthy *et al* (2004) who have reported that the seed cocoons of IInd crop or IIIrd crop harvest undergo pupal diapause and resume life cycle only after the onset of monsoon and the

availability of leaf of food plants. Further Kumar *et al* (2012) came out with similar type of findings with the agro shade net and concrete grainage houses under Jharkhand state conditions. Singh *et al* (2014) observed that higher pupal mortality (dead pupae), unseasonal moth emergence and less coupling percent are regular phenomena in seed cocoons preserved in concrete grainage house.

CONCLUSION:-

Behavioural and reproductive studies of *Larid ecorace*, *A. mylitta* D. were carried out by conducting the experiments under the two major heads i.e. (1) Reproductive performance under *Exsitu* and *Insitu* grainage conditions and (2) Rearing performance under *Exsitu* and *Insitu* grainage conditions of northern Chhattisgarh. It is concluded that, tasar silkworm, *A. mylitta* Daba BV Ecoraces diapausing seed cocoon preservation under agro shade net grainage house is better than concrete grainage house. Higher synchronized moth emergence, more coupling percentage, less span of emergence peak was found in cocoons preserved under agro shade net grainage, in comparison to concrete grainage house where higher pupal mortality, abnormal moths and less coupling percent were observed leading to low seed production. Agro shade net grainage house found suitable for the optimum temperature and relative humidity.

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