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ERRATIC EMERGENCE PATTERN OF SPRING AND SUMMER CROPS AND ITS EFFECT ON GRAINAGE PERFORMANCE OF *ANTHERAEA PROYLEI* JOLLY

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ABSTRACT

Moth emergence pattern during oak tasar seed cocoon preservation was observed from June to January (255±9.99 days) and from November to January (137±9.24 days) under normal room conditions. The seed cocoons harvested from the spring crop (March-April) started erratically emergence of moth from the month of June onwards till January showing the emergence of male 6.88% and female 4.60% totaling to 11.48% during the period of preservation. Whereas seed cocoons of summer crop (August-September) preserved under normal room conditions shows no erratic moth emergence whereas only pupal mortality recorded as 8.40%. The normal grainage performance of spring crop and summer crop was conducted during the month of February and recorded moth emergence, coupling percentage, cocoon dfl ratio and grainage span. The fecundity of spring to spring and summer to spring preservation cocoons were recorded as 113 and 132 nos. respectively. For additional crop, seed cocoons were subjected to 16-hour light treatment for a period of 25-30 days for grainage. Cocoons having the pupal age of 36±2.89, 51±2.89, 66±2.89 and 81±2.89 days were categorized into four different batches and consigned to 16-hour light treatment. Among the four batches, maximum moth emergence shows 87% in 36±2.89 days (1st batch) and minimum 35% in 81±2.89 days (4th batch) resulting in significant difference among the batches in moth emergence, cocoon dfl ratio, grainage span and initiation of moth emergence. However, there is no significant difference in coupling percentage and fecundity in all the four batches. The result reveals that age of the pupa is one of the important factors to response to light treatment for termination of diapause.

Keywords: *Antheraea proylei,* diapause, erratic emergence, light treatment, grainage, fecundity.

Introduction

In oak tasar culture, the spring crop is the successful crop which is for main seed and commercial and the additional crops during summer/autumn season showed inconsistency in crop success. Seed cocoons pupae produced during spring crop undergo pupal facultative diapause and required to be preserved till the next spring for preparing layings. Diapause is a state in which development of an organism is suppressed and metabolism decreased in order to survive during unfavourable environmental conditions. Environmental factors involved in induction and termination of diapause include temperature, photoperiod, humidity and diet, out of which the photoperiod is considered as the major factor (Beck, 1968; Saunders, 1981; Yamashita, 1996). Diapause is a hereditary characteristic triggered by an internal biological clock that brings about cessation of activity in advance of unfavourable conditions. This internal biological clock in turn is controlled by seasonal changes in day lengths and temperature. These environmental factors influence the neuro-secretary cells in either way. Thus, photoperiod and temperature are the two main factors for maintaining or terminating the diapause. Termination of diapause in oak tasar is successful through photoperiodic treatment (Kumar, 1981) and in *A. mylitta* (Jolly *et al.,* 1971).

During the course of preservation, the pupae faced abiotic/physical factors like temperature, humidity, photoperiod, etc which widely fluctuates in different months result in a substantial portion of the seed cocoon is lost due to erratic emergence and pupal mortality. Moreover, prolonged preservation of seed cocoons leads to reduction in fecundity, hatchability of eggs and increase in cocoon dfl ratio (Singh *et al.*, 2003; Sharma *et al.*, 2004). Therefore, it was felt necessary to study the erratic emergence pattern during seed cocoon preservation, seed cocoon recovery and its impact on fecundity.

Materials and Method

A. proylei seed cocoons were preserved from June to January as spring to spring and November to January as summer to spring under normal room condition. A total of 1500 live seed cocoons in triplicate of 500 numbers were garlanded @ 50 cocoons per garland and kept inside a wire mesh cages with proper spacing. For additional crop, 16-hours light treatment were given to seed cocoons in four batches at an interval of 15 days. The age of the pupae was recorded from 5th day of spinning and each group having the same age of 36 days. The female pupae were given light treatment five days earlier to the male pupae, so as to get uniform and synchronized emergence of male with female moths. During the light treatment, the maximum temperature 26±2°C, minimum temperature 24±2°C, relative humidity 80±5% and light intensity150±5 lux was maintained. The grainage performance was recorded in terms of male and female moth emergence, coupling percent, fecundity, cocoon DFL ratio and grainage span. The parameters recorded during the period of preservation were meteorological data, erratic emergence of moths. Pooled data were analyzed by following standard statistical methods separately for all the treatments for a conclusive interpretation.

Results and Discussion

The main constraints of oak tasar culture are weak bivoltine tendency in which *A. proylei* pupae exhibit facultative diapause for about 255±9.99 days in spring crop and 137± 9.24 days in summer crop. Seed cocoons were preserved from June to January as spring to spring and November to January as summer to spring under normal room condition. During spring to spring preservation, erratic moth emergence started from the month of June showing 0.24%, July-0.19%, August-0.05%, September-1.11%, October-0.23%, November-1.02%, December-2.27% and January-6.37% after the consignment of seed cocoons. The erratic emergence of male moth is 6.88% more than female moth 4.60% showing the total of 11.48% moth emergence during the eight months period of seed cocoon preservation, however, no emergence in seed cocoon preserved from November to January (Table-1). The percentage of erratic moth emergence gradually increases as the month progressed from June to January, indicating the development of pupa to moth by terminating the pupal diapause. Whereas in North West seed cocoons preserved at an altitude of 2000m ASL from August to February showed less than 1.00% erratic emergence and 20.00 – 29.12% pupal mortality (Tiken Singh *et al.*, 2001).

The maximum temperature ranges from 15.90°C to 27.46°C and minimum temperature ranges from 13.66°C to 25.00°C and relative humidity ranges from 83.02% to 88.31% RH was recorded in spring to spring preservation, while in autumn to spring preservation, the maximum temperature ranges from 15.90°C to 20.32°C and minimum temperature ranges from 13.66°C to 18.26°C and relative humidity ranges from 83.02% to 83.84% RH. It revealed that oak tasar pupae faced abiotic like temperature, humidity, photoperiod, etc which widely fluctuates in different months as a result a substantial portion of seed cocoon is lost due to erratic moth emergence and pupal mortality in spring to spring preservation whereas no erratic moth emergence was observed in summer to spring preservation except pupal mortality (Table-2). The daily light-dark cycle acts as main environmental cue (Saunders, 1982; Beck, 1983) for programming of diapause, but can be substituted by daily cycle of cold and warm temperature in Tropical insect species (Denlinger, 1979). In *Antheraea mylitta* developed a suitable infrastructure like underground grainage house for reducing the preservation loss due to erratic emergence and pupal mortality and also mud-walled grainage house (Raj Narayan *et al.*, 2001).

The total percentage of erratic emergence, pupal mortality and live cocoons recovered just before consignment for grainage in the month of February showed that 21.51% are loss due to erratic emergence and pupal mortality during prolong spring to spring preservation, as a result seed cocoon recovery was low 78.49%. In summer to spring preservation there was no erratic moth emergence only pupal mortality 8.40% as a result seed cocoon recovery was high 91.60% (Table-3). During the grainage, moth emergence 83.00%, Coupling 93.57% and fecundity 135 nos. was higher in summer to spring preservation compared to spring to spring preservation, whereas cocoon dfl ratio 5.30:1 was higher in spring to spring preservation (Table-4).

Light treatment was generally used for raising of additional crops in oak tasar culture during summer and autumn seasons (Kumar, 1981; Pandey *et al.*, 1992; Reeta *et al.*, 2010). First batch of light treatment was started from 1st June when the age of the pupa was 36 ± 2.89 days and was group into four batches and consigned for light treatment at an interval of 15 days. As a result, ages of pupae in subsequent batches were 51± 2.89, 66± 2.89 and 81± 2.89 days respectively. The percentage of moth emergence in different batches of light treatment showed significant difference among the batches (Table-5). During light treatment, the initiation of moth emergence shows significant difference among the batches. Moth emergence started after 22 days of light treatment in case of the first and second batch, in third batch after 23 days and in four batch after 25 days of light treatment indicating that as the age of pupae advances it take some more time to response to the light treatment for termination of diapause and delays moth emergence. Similarly in *A. mylitta*, injection of ecdysterone into diapausing pupae resulted in age- dependent responses of termination of diapause (Pradeep *et al*., 1997). It is also observed that the coupling percentage and fecundity shows no significant difference in all the treatments (Table-6). Similar finding also been reported by Benchamin *et al*., 1990 in *Bombyx mori* that different duration of photoperiodic treatment failed to affect fecundity and fertility as most of the oocyte maturation and spermatogenesis are completed before the treatment, which starts on the 6th days of spinning. The cocoons per dfl ratio declined drastically from 3.34:1 to 8.60:1 in the first to fourth batch showing significant differences among the batches. Thus, the result reveals that age of the pupa is one of the important factors to response to light treatment for termination of diapause for additional crop in oak tasar culture.

Table 1: Erratic moth Emergence pattern during seed cocoon preservation

Month	Progressive emergence pattern (%) ± S.D.					
	Spring to spring preservation			Autumn to spring preservation		
	Male	Female	Total	Male	Female	Total
June	0.05 ±0.08	0.19 ±0.33	0.24±0.21			
July	0.05 ±0.08	0.14 ±0.25	0.19±0.17			
August	0.00 ±0.00	0.05 ±0.08	0.05±0.04			
September	0.56 ±0.96	0.55 ±0.88	1.11±0.92			
October	0.09 ±0.08	0.14 ±0.25	0.23±0.17			
November	0.80 ±0.75	0.22 ±0.22	1.02±0.49	0.00	0.00	0.00
December	1.75 ±0.56	0.52 ±0.46	2.27±0.51	0.00	0.00	0.00
January	3.58 ±0.78	2.79 ±0.98	6.37±0.88	0.00	0.00	0.00
Total	**6.88**	**4.60**	**11.48**	**0.00**	**0.00**	**0.00**

Table 2: Meteorological data recorded during seed cocoon preservation

Month	Meteorological data (Mean ± S.D.)					
	Spring to spring preservation			Autumn to spring preservation		
	Temperature (° C)		RH (%)	Temperature (° C)		RH (%)
	Max.	Min.		Max.	Min.	
June	26.75 ±0.47	24.29 ±0.39	83.69 ±0.15			
July	27.46 ±0.32	25.00 ±0.26	87.31 ±0.69			
August	27.27 ±0.41	24.39 ±0.61	88.31 ±0.46			
September	26.28 ±0.27	23.83 ±0.17	85.13 ±0.61			
October	23.98 ±0.36	22.61 ±0.53	84.27 ±0.29			
November	20.32 ±0.81	18.26 ±0.56	83.84 ±0.33	20.32 ±0.81	18.26 ±0.56	83.84 ±0.33
December	16.52 ±0.29	14.36 ±0.47	83.56 ±0.41	16.52 ±0.29	14.36 ±0.47	83.56 ±0.41
January	15.90 ±0.64	13.66 ±0.43	83.02 ±0.50	15.90 ±0.64	13.66 ±0.43	83.02 ±0.50
Mean	**23.06 ±0.40**	**20.80±0.43**	**84.89 ±0.43**	**17.58 ±0.58**	**15.43 ±0.49**	**83.47 ±0.41**

Table 3: Total live seed cocoon recovery before grainage

Parameters	Erratic moth emergence (%)	Pupal mortality (%)	Live cocoons recovery before grainage (%)
Spring to spring preservation	11.48±0.42	10.03±1.51	78.49±3.74
Autumn to spring preservation	0.00±0.00	8.40±2.79	91.60±3.79

Table 4: Grainage performance of oak tasar seed cocoon preserved in *A. proylei*

Parameters	Moth Emergence (%)			Coupling (%)	Fecundity (Nos.)	Cocoon dfl ratio	Grainage span (Days)
	Male	Female	Total				
Spring to spring preservation	41.17 ±4.29	33.50 ±3.01	74.67 ±4.52	82.70 ±3.60	113 ±10.41	5.30 ±1.71	27 ±3.00
Autumn to spring preservation	44.67 ±2.95	38.33 ±2.05	83.00 ±2.00	93.57 ±1.18	135 ±6.70	3.60 ±0.59	18 ±2.00

Table 5: Pupal age response to 16-hour light treatment for termination of diapause

Consignment to light treatment	Avg. pupal age (Days)	Emergence initiation (Days)	Total moth emergence (%)
1st June	36±2.89	22±0.03	87±0.44
15th June	51±2.89	22±0.11	73±0.54
30th June	66±2.89	23±0.20	49±0.35
15th July	81±2.89	25±0.06	36±0.59

Table 6: Grainage performance of pupal age wise light treatment to oak tasar seed cocoons

Pupal age (Days)	Emergence (%)			Coupling (%)	Fecundity (no.)	Cocoon DFL ratio	Grainage span (days)	Initiation of moth emergence
	Male	Female	Total					
36±2.89	47.00	40.00	87.00	92.10	230	3.34	13.67	22
51±2.89	39.55	33.00	73.00	93.49	223	3.87	14.33	22
66±2.89	25.55	24.00	49.00	90.61	217	5.43	15.33	23
81±2.89	18.53	16.83	35.33	81.38	221	8.60	28.67	25
CD at 5%	**12.64**	**7.84**	**16.98**	**NS**	**NS**	**2.77**	**8.48**	**1.60**

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