

RESEARCH ARTICLE

Growth and grainage parameters of Eri silkworm, *Samia cynthia ricini* Boisduval (Lepidoptera : Saturniidae) as influenced by new hosts

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ARTICLE INFO

Received : 19.09.2013

Revised : 08.03.2014

Accepted : 16.03.2014

Key Words :

Growth and grainage, Parameters of Eri silkworm, Host plant, Mulberry silks, Castor crop, Tender leaves, Larval, Pupal, Egg, Total life cycle

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ABSTRACT

Studies were conducted on the growth and grainage parameters of Eri silkworm, *Samia cynthia ricini* boisduval on castor. There are several host tree plants included namely Fountain tree, banyan tree, Indian almond and carrot leaves. But only new host carrot leaves were next best host after standard check. Shortest life cycle was recorded during November-December (51.10 days). The interaction effect did not show any significant differences between host plants and the seasons

How to view point the article : Naik, C. Manjunatha and Murthy, C. (2014). Growth and grainage parameters of Eri silkworm, *Samia cynthia ricini* Boisduval (Lepidoptera : Saturniidae) as influenced by new hosts. *Internat. J. Plant Protec.*, 7(1) : 171-176.

INTRODUCTION

Sericulture being an important agro-based industry provides employment at various levels *i.e.*, host plant cultivation, silkworm rearing, reeling, spinning and weaving have much impact on the improvement of rural economy. In the global scenario, India is the world leader in tropical sericulture and stands second in raw silk production in the world next to China and produces 18.475 metric tonnes of mulberry raw silk. Apart from this, India also produces 1950 metric tonnes of non-mulberry silk in the 2012. Among non-mulberry silks, only Eri silk production is in increasing trend. India stands second in the world with respect to Eri silk production next only to China by producing 1485 metric tonnes. In northeastern region Eri silk production is 740 metric tonnes in Assam. Recently, ericulture is being introduced in Madhya Pradesh, Delhi, Punjab, Karnataka and Maharashtra Recently Eri-culture has been introduced in Southern states on castor and tapioca plants. But in recent years, area under castor and tapioca has come down due to many constraints in their cultivation. Though castor is the main host plant of Eri

silkworm, castor leaf is not available throughout the year particularly during summer and crop has to be sown every year. Moreover, its cultivation practices depend on rainfall condition resulting in uncertainty in raising the castor crop and inturn Eri-culture. Further, several pests and diseases affect the castor crop and in controlling them large quantity of chemicals are used frequently. The chemical sprayed leaves are harmful to Eri-silkworm. In the event of uncertainty in rainfall and harsh climatic conditions tree based Eri-culture is the need of hour. In this direction, search for alternate tree host plants available in the region for continuous Eri- silkworm rearing is essential.

MATERIAL AND METHODS

Investigations were carried out to know the growth, moth emergence, fecundity, incubation and hatching and duration of life cycle (days) of Eri silkworm, *Samia cynthia ricini* boisduval on new hosts during 2010-11 at DBT Ericulture Laboratory, Department of Agricultural Entomology, College of Agriculture, University of Agricultural Sciences, Dharwad,

Karnataka.

The rearing room along with rearing equipments were cleaned, washed thoroughly and disinfected properly with four per cent formalin using a gator rocker sprayer. After spraying, the rearing room was made air tight for 24 hr by closing all the windows and doors properly to make the disinfection process effective. The room was kept open for a minimum of 12 hr to remove the traces of formalin vapour left over in the room before the commencement of the rearing experiment. After two hours of hatching, one layer of tender leaves of different host plants were spread over the eggs in such a way as to just touch the eggs. After 10 to 15 minutes, the worms crawl on the under surface of the leaves. The leaves along with larvae were then transferred to a separate tray and turned upside down so as to bring the worms above the leaves. Eri silkworm rearing was conducted on castor (GCH-4), Fountain tree, Banyan tree, country almond tree and carrot leaves in shelf method. The Eri silkworm larvae were fed twice during first instars, thrice during second and third instars four times during fourth and fifth instars. The first three instars

worms were fed with tender leaves whereas the fourth and fifth instars worms with mature leaves.

Bed cleaning was carried out once in first instars (just before entering into the first moult), twice during second instar (once when all the worms came out of first moult and next one just before entering into second moult), thrice in third and fourth instars (first cleaning after all the worms came out of the previous moults, next in the middle of each instar and last just before the worms were entering into the next moult) and daily once in the fifth instar. The bed cleaning was done during morning hours.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Larval period (days):

The data pertaining to developmental period of Eri silkworm on new host plants were presented in Table 1. The

Table 1 : Duration of different stages of Eri silkworm on new host plants during (Nov.-Dec. and Jan.-Feb.)				
Treatments	Larval period (days)	Pupal period (days)	Egg period (days)	Total life cycle (days)
Host				
Castor - (GCH-4) (H-1)	21.50c	18.00	8.00	47.50b
Fountain tree (H-2)	27.05b	18.00	8.00	53.05a
Banyan tree (H-3)	28.25a	18.00	8.00	54.25a
Indian almond (H-4)	28.50a	18.00	8.00	54.50a
Carrot (H-5)	22.25c	18.00	8.00	48.25b
S. Em±	0.07	0.00	0.00	0.30
C.D. (P=0.01)	0.25	NS	NS	1.16
Season				
November-December (S1)	25.10	18.00	8.00	51.10
January-February (S2)	25.92	18.00	8.00	51.92
S. Em±	0.04	0.00	0.00	0.19
C.D. (P=0.01)	0.16	NS	NS	0.73
Interaction				
H ₁ × S ₁	21.00f	18.00	8.00	47.00
H ₁ × S ₂	22.00e	18.00	8.00	48.00
H ₂ × S ₁	27.00c	18.00	8.00	53.00
H ₂ × S ₂	27.10c	18.00	8.00	53.10
H ₃ × S ₁	28.00b	18.00	8.00	54.00
H ₃ × S ₂	28.50ab	18.00	8.00	54.50
H ₄ × S ₁	28.00b	18.00	8.00	54.00
H ₄ × S ₂	29.00a	18.00	8.00	55.00
H ₅ × S ₁	21.50ef	18.00	8.00	47.50
H ₅ × S ₂	23.00d	18.00	8.00	49.00
S. Em±	0.09	0.00	0.00	0.42
C.D. (P=0.01)	0.36	NS	NS	NS

Figures in the same column with similar alphabets do not differ significantly at P = 0.01 by DMRT

larval period was minimum on carrot (22.25 days) followed by fountain tree (27.05 days) and maximum larval period was noticed on Indian almond (28.50 days) which was on par with banyan tree (28.25 days). However, the standard check castor (GCH-4) recorded larval period (51.50 days) and found superior among rest of the host. The new host carrot leaves was next best host after standard check castor. Minimum larval period was recorded on November-December (25.10 days). In interaction, the significantly minimum larval period was recorded on castor during November-December (21.00 days), which was on par with carrot during November-December (21.50) and significantly maximum larval period was observed in Indian almond during January-February (29.00 days).

Pupal period (days) :

Non-significant differences were recorded with regard to host plants, season and interaction.

Egg period (days):

Non-significant differences were recorded with regard

to host plants, season and interaction Sannappa et al. 2007.

Total life cycle (days):

The host plants had significant effect on the total life cycle and shortest life cycle being on carrot (48.25 days). The longest life cycle was noticed in Indian almond (54.50 days) which was on par with banyan tree (54.25 days) and fountain tree (53.05 days). However, the standard check castor (GCH-4) recorded total life cycle (47.50 days) and was found superior among rest of the hosts. The new host carrot leaves was next best host after standard check. Shortest life cycle was recorded during November-December (51.10 days). The interaction effect did not show any significant difference between host plants and the seasons.

The data pertaining to moth emergence, normal, deformed moth and sex ratio are presented in Table 2.

Moth emergence (%):

Host plants had a profound influence on the moth emergence. Among new host, as high as 99.42 per cent moth

Table 2 : Effect of different host plants on moth emergence, deformity and sex ratio of Eri silk moth during (Nov.-Dec. and Jan.-Feb.)				
Treatments	Moth emergence (%)	Normal moth (%)	Deformed moth (%)	Sex ratio (M:F) (%)
Host				
Castor-(GCH-4) (H-1)	99.42 a (85.60)	99.29a (85.13)	0.13d (2.06)	1.21a (6.31)
Fountain tree (H-2)	99.40a (85.52)	98.83a (83.76)	1.07c (5.93)	1.15b (6.16)
Banyan tree (H-3)	99.35a (85.35)	98.20b (82.26)	1.15c (6.15)	1.12c (6.08)
Indian almond (H-4)	99.30a (85.17)	97.87b (81.58)	1.43b (6.86)	1.12c (6.07)
Carrot (H-5)	99.00b (84.23)	97.87b (80.28)	1.83a (7.77)	1.06d (5.92)
S. Em±	0.03	0.03	0.009	0.001
C.D. (P=0.01)	0.11	0.12	0.036	0.003
Season				
November-December (S ₁)	100 (89.96)	98.96 (84.11)	1.04 (5.86)	1.16 (6.19)
January-February (S ₂)	98.58 (83.34)	97.87 (81.58)	1.20 (6.29)	1.11 (6.04)
S. Em±	0.02	0.02	0.006	0.001
C.D. (P=0.01)	0.07	0.08	0.023	0.002
Interaction				
H ₁ × S ₁	100.00a (89.96)	99.90a (88.15)	0.10g (1.81)	1.24a (6.39)
H ₁ × S ₂	98.84b (83.78)	98.68bc (83.37)	0.16g (2.29)	1.18b (6.23)
H ₂ × S ₁	100.00a (89.96)	99.00b (84.23)	1.00f (5.74)	1.24b (6.23)
H ₂ × S ₂	98.80b (83.68)	98.66cd (83.32)	1.14e (6.13)	1.18d (6.09)
H ₃ × S ₁	100.00a (89.96)	98.90bc (83.95)	1.10ef (6.02)	1.16c (6.18)
H ₃ × S ₂	98.70bbc (83.43)	97.50e (80.87)	1.20e (6.29)	1.09e (5.98)
H ₄ × S ₁	100.00a (89.96)	98.64cd (83.27)	1.36d (6.69)	1.16c (6.17)
H ₄ × S ₂	98.60bc (83.17)	97.10f (80.16)	1.50c (7.03)	1.09e (5.98)
H ₅ × S ₁	100.00a (89.96)	98.34d (82.56)	1.66b (7.40)	1.13d (6.10)
H ₅ × S ₂	98.00bc (81.84)	96.00ef (78.43)	2.00a (8.13)	1.00f (5.74)
S. Em±	0.0c4	0.05	0.013	0.001
C.D. (P=0.01)	0.16	0.18	0.051	0.004

Figures in the parenthesis are arc sine transformation, Figures in the same column with similar alphabets do not differ, Significantly at P = 0.01 by DMR

emergence was recorded fountain tree (99.40%) this was on par with banyan tree (99.35%) and Indian almond (99.30%). However, carrot (99.00%) had significantly lower moth emergence. The standard checks castor (GCH-4) recorded moth emergence (99.40 %) and was found superior among rest of the host. The new host fountain tree was next best host after standard check castor.

Significant interaction effects were seen with respect to host plants and season. Significantly one hundred per cent moth emergence was recorded on castor during November-December, fountain tree during November-December, banyan tree during November-December, Indian almond during November-December, carrot during November-December which are on par with each other, significantly minimum moth emergence was found on carrot leaves January-February (98.00%).

Normal moth (%):

Significant differences were noticed in respect of different host plants. Among new host highest normal moth was recorded on fountain tree (98.83%), lowest normal moth on carrot (97.87%) which was on par with Indian almond

(97.87%) and banyan tree (98.20%) respectively. However, the standard check castor (GCH-4) recorded normal moth (99.29 %) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. Maximum moth emergence was recorded during November-December (98.96%).

Significant interaction effects were seen with host plants and season significantly highest normal moth per cent was recorded on castor during November-December (99.90%) followed by fountain tree during November-December (99.00%), which was on par with castor during January-February (98.68%), banyan tree during November-December (98.90%). However, it was significantly lowest normal moth per cent recorded on carrot leaves during January-February (96.00%).

Deformed moth (%):

Significant difference was observed in host plants minimum deformed moth was noticed on fountain tree (1.07%) which was on par with banyan tree (1.15%), followed by Indian almond (1.43) and it was maximum deformed moth was observed on carrot leaves (1.83%). The standard check castor (GCH-4)

Table 3 : Influence of new hosts on number of eggs per laying and hatchability of Eri silkworm (Nov.-Dec. and Jan.-Feb.)

Treatments	I day laid egg	II day laid egg	III day laid egg	Total number of eggs	Fertile eggs	Unfertile eggs	Dead eggs	Hatching (%)
Host								
Castor (GCH-4) (H-1)	171.31a	130.11a	32.08a	339.50a	317.45a	11.50b	4.55e	95.18a (77.28)
Fountain tree (H-2)	170.73a	127.68b	31.09a	329.50a	308.84b	14.50	6.17d	93.72b (75.46)
Banyan tree (H-3)	155.25b	124.52c	27.24b	307.50b	285.17c	15.00b	6.83c	92.89c (74.51)
Indian almond (H-4)	144.75c	120.30d	25.95b	291.00c	266.30d	17.00b	7.70b	91.49d (73.01)
Carrot (H-5)	138.09d	108.67e	25.75b	272.50d	237.67e	25.80a	9.04a	87.19e (69.00)
S. Em ±	0.36	0.16	0.14	0.60	0.52	0.41	0.05	0.003
C.D. (P=0.01)	1.38	0.61	0.55	2.33	2.04	1.59	0.20	0.11
Season								
November-December (S ₁)	158.73	123.97	30.30	313.00	290.74	15.79	6.47	92.73 (74.33)
January-February (S ₂)	153.31	120.54	26.54	300.40	275.43	17.73	7.24	91.45 (72.97)
S. Em±	0.22	0.10	0.09	0.38	0.33	0.26	0.03	0.02
C.D. (P=0.01)	0.87	0.38	0.35	1.47	1.298	1.01	0.12	0.07
Interaction								
H ₁ × S ₁	173.33a	132.67a	34.00a	340.00a	324.90a	11.00e	4.10h	95.56a (77.80)
H ₁ × S ₂	169.28b	127.56bc	30.16b	327.00b	310.00b	12.00de	5.00g	94.80b (76.79)
H ₂ × S ₁	172.67a	129.00b	33.33a	335.00a	314.67b	14.33cde	6.00f	93.93a (75.70)
H ₂ × S ₂	168.79b	126.36cd	28.85cd	322.00b	303.00c	14.67cde	6.33ef	93.52b (75.22)
H ₃ × S ₁	157.00c	125.33d	29.67bc	312.00c	290.33d	15.00cd	6.67d	93.06a (74.70)
H ₃ × S ₂	153.50d	123.70e	24.80f	302.00d	280.00e	15.00cd	7.00cd	92.72a (74.32)
H ₄ × S ₁	151.00d	122.50e	26.50e	300.00d	276.80e	16.00d	7.20c	92.27a (73.83)
H ₄ × S ₂	138.50ef	118.10f	25.40ef	282.00e	255.80f	18.00c	8.20b	90.71c (72.23)
H ₅ × S ₁	139.67e	110.33g	28.00d	278.00f	247.00g	22.60b	8.40b	88.85b (70.46)
H ₅ × S ₂	136.50f	107.00h	23.50g	267.00f	228.33h	29.00a	9.67a	85.52c (67.61)
S. Em±	0.50	0.22	0.20	0.85	0.74	0.58	0.07	0.04
C.D. (P=0.01)	1.95	0.85	0.78	3.29	2.88	2.25	0.28	0.16

Figures in the parenthesis are sine transformation, Figures in the same column with similar alphabets do not differ significantly at P = 0.01 by DMR

recorded deformed moth (0.13 %) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. In season had a significantly minimum deformed moth observed during November-December (1.04%) Ravishankar et al. 2000.

Significant interaction effects were seen with host plants and season significantly minimum deformed moth was recorded on castor during November-December (0.10%) which was on par with castor during January-February (0.16%) followed by fountain tree during November-December (1.00%) which was on par with banyan tree during November-December (1.10%) However, significantly maximum deformed moth was observed on carrot leaves during January-February (2.00%).

Sex ratio (%):

Host plants markedly influenced the sex ratio significantly highest sex ratio was recorded fountain tree (1.15%) and banyan tree (1.12%) which was on par with Indian almond (1.12%). lowest sex ratio was observed on carrot leaves (1.06%). However, the standard check castor (GCH-4) recorded sex ratio (1.21 %) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. However, significantly highest sex ratio was observed during November-December (1.16%).

In interaction effect of host plants and season also showed significant differences significantly highest sex ratio was observed on castor during November-December (1.240%) followed by fountain tree during November-December (1.240%) which was on par with castor during January-February (1.180%) Hazarika et al. 2003. However, significantly lowest sex ratio was observed on carrot leaves during January-February (1.00%).

Fecundity and hatching percentage:

The data on the first, second, third day laid eggs, total eggs, fertile egg, unfertile egg, dead egg and hatching (%) were presented in Table 3 First day laid egg: Significant differences were found in respect of 1st day laid egg among the new host plants, highest 1st day laid egg was recorded on fountain tree (170.73) followed by banyan tree (155.25) and Indian almond (144.75) respectively. Lowest was on carrot leaves (138.09). However, the standard check castor (GCH-4) recorded first days laid egg (171.31) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. First day laid egg was significantly more during November-December (158.73).

The interaction effect was significantly maximum being on castor during November-December (173.33) which was on par with fountain tree during November-December (172.67). Whereas significantly minimum on carrot during January-February (136.50).

Second day laid egg :

Significant differences were found in respect of second day laid egg among the new host plants, highest second day laid egg was recorded on fountain tree (127.68) followed by banyan tree (124.52) and Indian almond (120.30). Lowest was on carrot leaves (108.67). However, the standard check castor (GCH-4) recorded second day laid egg (130.11) and found superior among rest of the host plants. The new host fountain tree was next best host after standard check. Second day laid egg was markedly more during November-December (123.97).

The interaction effect was significantly maximum being on castor during November-December (132.67) followed by fountain tree during November-December (129.00). Significantly maximum second day laid egg was observed on carrot leaves during January-February (107.00).

Third day laid egg:

Significant differences were found in respect of third day laid egg among the host plants. Highest third day laid egg was recorded on fountain tree (31.09) and lowest on carrot leaves (25.75), banyan tree (27.24) and Indian almond (25.95) which was on par with each other. However, the standard check castor (GCH-4) recorded third day laid egg (32.08) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. However, significantly higher third day laid egg was observed during November-December (30.30).

The interaction effect was significantly with maximum being on castor during November-December (34.00) which was on par with fountain tree during November-December (33.33). However, significantly minimum third day laid egg was observed on carrot leaves during January-February (23.50).

Fecundity:

Significant differences were found in respect to fecundity among the host plants, highest fecundity was observed on fountain tree (329.50) followed by banyan tree (307.50) and Indian almond (291.00) respectively. Lower fecundity was noticed on carrot leaves (272.50). However, the standard check castor (GCH-4) recorded fecundity (339.50) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. Significantly maximum fecundity during November-December (313.00).

In interaction of host plants and season also significant difference were noticed significantly highest fecundity was observed on castor during November-December (340.00) which was on par with fountain tree during November-December (335.00). However, significantly lower fecundity on carrot leaves during January-February (267.00).

Fertile egg:

New host plants showed marked variations in respect of

fertile egg. Highest fertile egg was on fountain tree (308.84) followed by banyan tree (285.17) and Indian almond (266.30) respectively. Lowest fertile egg was observed on carrot leaves (237.67). However, the standard check castor (GCH-4) recorded fertile egg (317.45) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. Significantly maximum fertile egg during November-December (290.74).

In interaction of host plants and season also significant difference were noticed significantly highest fertile egg was noticed on castor during November-December (324.90) followed by fountain tree during November-December (314.67) which was on par with castor during November-December (310.00). However, significantly lowest fertile egg was observed on carrot leaves during January-February (228.33).

Unfertile egg:

Minimum unfertile egg was observed on fountain tree (14.50) which was on par with banyan tree (15.00) and Indian almond (17.00) respectively. Maximum unfertile egg was noticed on carrot leaves (25.80). However, the standard check castor (GCH-4) recorded unfertile egg (11.50) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. Significantly maximum unfertile egg during November-December (15.79).

Interaction of host plants and season were also significantly different. The significantly minimum unfertile egg was noticed on castor during November-December (11.00) which was on par with castor during January-February (12.00), fountain tree during November-December (14.33) and significantly maximum unfertile egg was noticed on carrot leaves during January-February (29.00).

Dead egg:

Significantly minimum dead egg was observed on fountain tree (6.17) followed by banyan tree (6.83) and Indian almond (7.70) respectively. Maximum dead egg was noticed on carrot leaves (9.04). However, the standard check castor (GCH-4) recorded dead egg (4.55) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. Significantly maximum dead egg during November-December (6.47).

Interaction of host plants and seasons were also significantly different. The significantly minimum dead egg was found on castor during November-December (4.10), followed by castor during January-February (5.00) and fountain tree during November-December (6.00) which was on par with fountain tree during January-February (6.33). However, significantly maximum dead egg was observed on

carrot leaves during January-February (9.67).

Hatchability (%):

Notable differences were observed with regard to the hatchability of eggs. Highest hatching per cent on fountain tree (93.72%) followed by banyan tree (92.89%) and Indian almond (91.49%), respectively and lowest hatching per cent was noticed on carrot leaves (87.19%). However, the standard check castor (GCH-4) recorded hatchability (95.18 %) and found superior among rest of the host. The new host fountain tree was next best host after standard check castor. Hatchability was significantly higher during November-December (92.73%). The interaction effect was significant with maximum being on castor during November-December (95.56%) which was on par with fountain tree during November-December (93.93%), banyan tree during November-December (93.06%) banyan tree during January-February (92.72%) and Indian almond during November-December (92.27), respectively. The hatchability was significantly minimum carrot during January-February (85.52%).

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