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LIFE CYCLE OF LAC INSECT, *KERRIA LACCA* KERR IN SIMILIPAL BIOSPHERE RESERVE

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ABSTRACT

Lac a natural resin is secreted by a tiny scale insect, *Kerria lacca* Kerr. Its primary host plants such as kusum (*Schleichera oleosa*), palas (*Butea monosperma*) and ber (*Zizyphus mauritiana*) are available in peripheral and buffer zones of Similipal Biosphere Reserve (SBR). An attempt has been made to study its life cycle and life span in different zones of SBR. Two strains, i.e., kusmi and rangeeni of lac insect are bivoltine in nature at SBR. The longest life span of 8 months 5 days was observed in baisakhi (summer) crop and shortest life span of 3 months 16 days is seen in katki (rainy) crop of rangeeni strain on palas tree in peripheral zone. The buffer zone also showed the same trend. The life span of young ranges from 44-111 days for all the crops, strains and host plants. The life span of adult male is 2-3 days and the life span of female insect varies between 62-148 days for different crops. The variation of life span of male, female as well as young occurs due to temperature, host plants and strains of lac insect.

Key words: Lac insect (*Kerria lacca*), resin, kusmi strain, rangeeni

Lac is the only resin of animal origin, being the secretion of a tiny scale insect, *Kerria lacca* Kerr (Tachardiidae: Homoptera). In India lac insect is distributed in the forests of Himalayan terai, Deccan penninsula (hilly regions of Jharkhand, West Bengal, Odisha, Madhya Pradesh and Uttar Pradesh), semi-arid regions of Rajasthan and Gujarat and the North-eastern boundary (Assam). The life cycle of lac insect starts with first instar larval stage, the crawlers. The crawlers after settlement undergo three successive moultings to become the adult.

The present work has been undertaken to study the life cycle and life span in Similipal Biosphere Reserve (SBR) in Odisha.

MATERIALS AND METHODS

The study was conducted at the Similipal Biosphere Reserve, Mayurbhanj, Odisha during 2006-09. The altitude of SBR varies from 50 to 1,150 m ASL with valley, plain and hilly forests. Survey was taken up in two different zones of SBR with having diversified forest types of which the salient weather details are given in Table 1. These places were Jadida, Jadunathpur (100-200 m ASL) and Chakidi (200-300 m ASL) in peripheral zone and Notto (400-500 m ASL), inner Kendumundi (500-600 m ASL) and Gudugudia (800-900 m ASL) in buffer zone (Tripathy and Patro, 1997). As per the record of Forest Department the areas in which major host plants (palas, kusum and ber) are found were taken as study sites. Culture method of lac was adopted as per Indian Institute of Natural Resins and Gums (IINRG). Temperature, humidity and rainfall were recorded.

The kusmi strain grown on kusum and rangeeni strain on host plant palas were studied. Pruning of trees were done 6 and 12 months before inoculation of lac insect for palas and kusum plants, respectively. Pruning time of ber plant was same as kusum (Kumar *et al*., 2002) and application of pesticides and crop harvesting were done (Sharma and Jaiswal, 2002).

Life cycle and life span were calculated by observing the date of settlement of crawlers, emergence of male and emergence of larva after the date of inoculation (Jaiswal and Sharma, 2002). For both kusum and ber plants, the Aghani crop was inoculated in 1st and 2nd week of July (1-5 July in peripheral and 5-9 July in buffer zone), Jethwi in peripheral zone in January (23-28 January on kusum and 21-25 January on ber) and in buffer zone in February (3-9 February for both the plants). For palas, the katki crop was inoculated in 2nd week of July (8-12 July in peripheral zone and 6-12 July in buffer zone) and for baisakhi crop inoculation was done in November (8-12 November in peripheral zone and 5-9 November in buffer zone) (Tables 2, 3). A gap of 2-3 days for

Table 1. Meteorological parameters of study sites in SBR

Study site	Altitude (m ASL)	Season	Atmospheric temperature			Relative humidity (%)	Rainfall (mm)
			Max. temp.(^{0}C)	Min. temp. (^{0}C)	Average temp. (^{0}C)		
Peripheral zone (Outer zone)	100-300	Summer	40.10 (01.10)	22.00 (0.69)	31.50 (0.37)	78.00 (01.98)	34.20 (10.42)
		Rainy	36.50 (01.10)	23.25 (0.45)	29.88 (0.75)	89.00 (03.20)	180.30 (38.10)
		Autumn	34.55 (0.25)	22.25 (0.25)	28.40 (0.30)	92.25 (01.15)	257.20 (41.40)
		Dew	32.70 (01.10)	18.75 (01.05)	25.73 (01.10)	90.25 (03.05)	69.70 (39.10)
		Winter	27.20 (01.50)	15.00 (0.70)	21.10 (01.10)	85.60 (01.70)	6.20 (01.00)
		Spring	34.20 (01.19)	17.80 (01.45)	26.00 (01.20)	73.30 (04.75)	16.80 (01.60)
Buffer zone (Middle zone)	500-600	Summer	36.80 (0.55)	20.20 (01.09)	28.50 (0.42)	67.90 (05.73)	38.00 (13.61)
		Rainy	33.60 (01.00)	20.85 (0.15)	27.23 (0.55)	80.45 (04.05)	200.00 (25.40)
		Autumn	30.70 (0.20)	20.45 (0.05)	25.57 (01.00)	84.50 (02.10)	283.70 (12.10)
		Dew	29.50 (01.20)	17.15 (01.15)	23.33 (01.15)	79.65 (01.45)	103.50 (63.00)
		Winter	25.05 (01.55)	14.35 (0.60)	18.93 (0.15)	69.35 (01.15)	06.30 (0.10)
		Spring	31.80 (01.24)	16.60 (0.09)	23.20 (0.66)	63.50 (03.28)	16.30 (2.25)

Figures in parentheses are ± SD values.

Table 2. Life cycle (days) of lac insect, *Kerria lacca* (Kerr) vs. host plants (peripheral zone)

Host plant	Strain	Crop	Date of inoculation	Date of settlement of larva	Date of male emergence	Date of larval emergence	Duration of life cycle
Schleichera oleosa (Kusum)	Kusmi	Aghani (winter)	01-05 July	15-21July	15-19 Aug.	15-21 Jan.	196
		Jethwi (summer)	23-28 Jan.	5-10 Feb.	23-28 March	25-30 June	155
Butea monosperma (Palas)	Rangeeni	Katki (rainy)	08-12 July	28 July-02 Aug.	21-25 Aug.	22-26 Oct.	106
		Baisakhi (summer)	08-12 Nov.	28 Nov.-02 Dec.	27 Feb.-03 March	10-14 July	245
Zizyphus mauritiana (Ber)	Kusmi	Aghani (winter)	01-05 July	12-18 July	13-17 Aug.	08-14 Jan.	191
		Jethwi (summer)	21 -25 Jan.	07- 11 Feb.	18-22 March	19-23 June	150

inoculation in peripheral and buffer zones was made for better observations. The same pattern was followed throughout the whole period of study.

By substracting the date of inoculation from the date of male emergence, life span of young-ones was calculated. Total life span of male was calculated by adding the adult life period with young period. Similarly, the life span was calculated by substracting the date of inoculation from the date of emergence of larva. The life period of adult female was calculated by substracting the young period from the life span of the insect. As the male dies 2-3 days after emergence and copulation, the life cycle of this insect is actually the life span of female insect.

Table 3. Life cycle (days) of lac insect, *Kerria lacca* (Kerr) vs. host plants (buffer zoneof SBR)

Host plant	Strain	Crop	Date of inoculation	Date of settlement of larva	Date of male emergence	Date of larval emergence	Duration of life cycle
Schleichera oleosa (Kusum)	Kusmi	Aghani (winter)	05-09 July	25-30 July	24-29 Aug.	23-28 Jan.	202
		Jethwi (summer)	03-09 Feb.	24-28 Feb.	12-18 April	15-21 July	162
Butea monosperma (Palas)	Rangeeni	Katki (rainy)	06-12 July	26-31 July	20-26 Aug.	27 Oct.-03 Nov.	112
		Baisakhi (summer)	05-09 Nov.	25-29 Nov.	24-28 Feb.	18-24 July	253
Zizyphus mauritiana (Ber)	Kusmi	Aghani (winter)	05-09 July	23-28 July	22-27 Aug.	21-26 Jan.	199
		Jethwi (summer)	03-09 Feb.	24-28 Feb.	08-13 April	10-16 July	158

RESULTS AND DISCUSSION

Life cycle and life span: The date of larval settlement, emergence of male and larva were recorded. In the Aghani crop of kusmi strain on kusum plant in peripheral zone of SBR the settlement of larva between 15-21 July, male emergence between 15-19 August and larval emergence between 15-21 January were completed. On ber plant it was 12-18 July, 13-17 August and 8-14 January, respectively. In the jethwi crop on kusum plant in peripheral zone the dates were 5-10 February, 23-28 March and 25-30 June for larval settlement, male and larval emergence, respectively. It was 7-11 February, 18-22 March and 19-23 June, respectively for above three events on ber plant for jethwi crop (Table 2). In katki crop of rangeeni strain on palas plant in peripheral zone the larva settled between 28 July and 2 August, the male insect emerged between 21-25 August and the larva emerged between 22-26 October. In baisakhi crop of rangeeni strain on Palas tree it were 28 November to 2 December, 27 February to 3 March and 10-14 July, respectively for larval settlement, male and larval emergence (Table 2).

In the aghani crop on kusum plant in buffer zone the settlement of larva between 25-30 July, the male emergence between 24-29 August and larval emergence between 23-28 January were completed. On ber plant it was 23-28 July, 22-27 August and 21-26 January, respectively. In the jethwi crop on kusum plant in buffer zone the dates were 24-28 February, 12-18 April and 15-21 July for larval settlement, male and larval emergence, respectively. It was 24-28 February, 08-13 April and 10-16 July, respectively for above three events on ber for jethwi. In katki crop of rangeeni strain on palas plant in buffer zone the larva settled between 26-31 July, the male insect emerged between 20-26 August and the larva emerged between 27 October-03 November. In baisakhi crop of rangeeni strain on palas tree it were 25-29 November, 24-28 February and 18-24 July, respectively for larval settlement, male and larval emergence (Table 3).

In the peripheral zone of SBR the duration of life cycle/life span (date of inoculation to date of larval emergence) of winter crop (Aghani) of kusmi strain on kusum plant was 196 days (on an average) (6M 16D) whereas it was 191 days (6M 11D) in ber (Table 4). However, the longest duration of life cycle (span) of 245 days (8M 5D) found in case of summer crop (baisakhi) of rangeeni on palas plant. Whereas in the summer crop (jethwi) on kusum and ber trees these were 155 days (5M 5D) and 150 days (5M), respectively. On the other hand, the shortest life cycle (life span) 106 days (3M 16D) was found for rainy crop (katki) of rangeeni on palas tree (Table 4). The duration of life cycle (life span) in buffer zone showed the same trend as that of peripheral zone, i.e., baisakhi had longest of 253 days (8M 13D) and katki has shortest of 112 days (3M 22D) (Table 5).

In the peripheral zone of winter crop on kusmi strain of kusum plant the life span of young was 46 days whereas it was 44 days on ber plant. In summer crop of kusmi strain it was 59 days for Kusum and 57 days for ber plant. Rangeeni strain of summer crop (Baisakhi) had the longest life duration of 111 days and 44 days for rainy crop (katki) in palas plant (Table 4). The adult female insect in winter crop (aghani) of kusum plant had the maximum life span of 150 days and ber had 147 days. The summer crop (jethwi) in kusum plant showed the life span of adult female insect about 96 days whereas it was 93 days for ber plant. Palas plant of rainy crop (katki) had smaller life span

Table 4. Life span (days) of lac insect, *Kerria lacca* (Kerr) vs host plants (peripheral zone of SBR)

Host plant	Strain	Crop	Life span of young	Life span of male insect		Life span of female insect	
				Adult	Total	Adult	Total
Schleichera oleosa (Kusum)	Kusmi	Aghani (winter)	46	02	48	150	196
		Jethwi (summer)	59	02	51	96	155
Butea monosperma (Palas)	Rangeeni	Katki (rainy)	44	02	46	62	106
		Baisakhi (summer)	111	03	114	134	245
Zizyphus mauritiana (Ber)	Kusmi	Aghani (winter)	44	02	46	147	191
		Jethwi (summer)	57	02	59	93	150

Table 5. Life span (days) of lac insect, *Kerria lacca* (Kerr) vs host plants (buffer zone of SBR)

Host plant	Strain	Crop	Life span of young	Life span of male insect		Life span of female insect	
				Adult	Total	Adult	Total
Schleichera oleosa (Kusum)	Kusmi	Aghani (winter)	49	02	51	153	202
		Jethwi (summer)	68	02	70	94	162
Butea monosperma (Palas)	Rangeeni	Katki (rainy)	45	02	47	67	112
		Baisakhi (summer)	113	03	116	140	253
Zizyphus mauritiana (Ber)	Kusmi	Aghani (winter)	48	02	50	151	199
		Jethwi (summer)	66	02	68	92	158

(62 days) than summer crop (134 days) (Table 4). It was observed that adult male existed for 2-3 days. The life span of adult male varied from 46 days (1M 16D) to 116 days (3M 26D) on different crops and host plants in both the zones (Tables 4, 5).

The similar trend was seen in buffer zone of summer crops (baisakhi) of rangeeni strain with longest life span of young and adult female, i.e., 113 and 140 days, respectively and rainy crop (katki) had shortest, i.e., 45 and 67 days (Table 5). As the life cycles (life span) in both the strains kusmi (aghani and jethwi crops) and rangeeni (katki and baisakhi crops) were continued twice in a year, the insect is bivoltine in nature. It was observed that in host plants, namely kusum, palas and ber, the life cycle for all the strains and crops in buffer zone were 6-8 days more than the peripheral zone (Tables 4, 5). This may be due to difference in temperature between two zones. The temperature is 2-3^{0}C less in buffer zone than the peripheral zone (Table 1). Temperature greatly influences the biological attributes (Srinivasan, 1956; Mishra *et al.*, 1999a, b; Bhagat and Mishra, 2002; Sharma, 2007). At IINRG, Namkum the aghani and jethwi crops of kusmi strain have 199 and 159 days, respectively and katki and baisakhi crops of rangeeni strain have 109 and 250 days, respectively. These are in agreement with earlier findings (Jaiswal and Sharma, 2002).

The present results also revealed that the strains are bivoltine (Table 4, 5) at SBR as reported for other places. It was found that in peripheral zone of SBR, aghani and jethwi crops of kusmi strain on kusum tree took 6 months 16 days, and 5 months 5 days, respectively. Similarly, katki and baisakhi crops of rangeeni strain on palas tree took 3 months 16 days, and 3 months 5 days, respectively (Table 2, 4). In buffer zone of SBR, aghani and jethwi crops of kusmi strain on kusum tree took 6 months 22 days and 5 months 12 days, respectively. The katki and baisakhi crops of

rangeeni strain on palas tree took 3 months 22 days and 8 months 13 days, respectively (Table 3, 5). It is well within the range reported by earlier workers (Kapur, 1962; Jaiswal and Sharma, 2002). The longer period of baisakhi crop of rangeeni strain is attributed to high temperature of summer months (Bhagat and Mishra, 2002) and also the kusmi and rangeeni biotypes are generally distinct (Chauhan and Lal, 1982; IINRG Ann. Rep., 2009-10). In case of kusmi strain on ber tree aghani crop took 6 months 11days in peripheral zone (Table 2, 4) whereas in buffer zone it took 6 months 19 days (Table 3, 5). For jethwi crop of peripheral zone it was 5 months (Tables 2, 4) and for buffer zone it was 5 months 8 days (Table 3, 5).

The insect starts its life as a larva or nymph. The larva undergoes three moults to become adult. The life span of young of aghani crop was 6 week 4 days and 7 weeks for peripheral and buffer zones, respectively. The corresponding values for jethwi crop for both the zones were 8 weeks 3 days and 9 weeks 5 days, respectively. Jaiswal and Sharma (2002) opined that the total life period of young of aghani crop is 7 weeks and that of jethwi is 11 weeks. Similarly, the total life span of young, male and female insects (Table 4, 5) were either equal or slightly less than that reported by Jaiswal and Sharma (2002) at IINRG. The mean minimum temperature varied between 6.4^{0}C in December to 25.2^{0}C in June and mean maximum temperature varied between 25.5^{0}C in January and 40.6^{0}C in May with a heavy rainfall pattern of about 1,400 mm at experimental farm of IINRG. The average rain fall recorded for present study was about 1,130 mm and 1,300 mm in peripheral and buffer zones of SBR (Table 1), respectively. However, it is more in core area. The lowest temperature during study period in December was 15.7^{0}C and 13.9^{0}C in peripheral and buffer zones, respectively. Hence, slightly higher temperature and lower average rainfall in the study sites (SBR) than Ranchi region where IINRG is located may be one of the causes for shorter life span of the lac insect at SBR. Moderately higher temperature and less rainfall of this region cause early shedding of leaves and the sap content of host plant also dries.

There was a non-significant ($P < 0.2$) negative correlation ($r = - 0.645$) resulted between temperature and duration of life cycle in peripheral zone. Similar trend was also noticed ($P < 0.6$; $r = - 0.309$) in buffer zone.

The non-significant negative corelation in these and other zones indicates that the rise in temperature reduce the duration of life cycle (period) in lac insect. Other environmental factors such as rainfall, humidity and wind also influence lac production (Bhagat and Mishra, 2002). The life span of this insect is also 6-8 days more in buffer zone than that of the peripheral zone which may be the result of difference in temperature and other climatological factors.

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