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Performance evaluation of lac insect *Kerria maduraiensis* on different host plants at Thrissur, Kerala

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Abstract
The current study focused on how lac insect *Kerria maduraiensis* grown on four different host plants: *Flemingia semialata*, *Flemingia macrophylla*, *Butea monosperma*, and *Amherstia nobilis*. Each host plant received five replicas of the broodlac insect (5 gram each). Lac insect productivity-related metrics such as first density of settlement, early mortality, male percentage, and survival at crop maturity were calculated for each group and compared. The performance of *K. maduraiensis* was better on *B. monosperma* compared to other hosts. At crop maturity, *B. monosperma* had the uppermost mean number of female lac insects (8.40±1.14) and the highest mean number of female cell density. On the host plant, *B. monosperma*, the mean number of mortalities was (5.84±4.63), which was found to be low. Also, the mean number of male cells was calculated and found to be significantly lower in the *B. monosperma* plant than in the other groups. According to the results of the current study, *B. monosperma* is observed to be a good host plant of *K. maduraiensis* and thus identified that *B. monosperma* trees can be used as a host plant tree for the lac insect cultivation in the state of Kerala. The study also identified *Hyblaea puera* Cramer (Teak defoliator) as a new pest on *Flemingia* species (*F. semialata* and *F. macrophylla*).

Keywords: *Kerria maduraiensis*, *Butea monosperma* and *Hyblaea puera*

Introduction
Lac, the only natural resin of animal origin is secreted by the soft bodied lac insect (Homoptera; Coccoidea; Tachardiidae) throughout of its lifecycle. Two genera and 19 species of lac insects have been reported from India and the most common Indian lac insect of commercial importance is *Kerria lacca* (Kerr.), which thrives on the tender twigs of specific host plants. (Sharma *et al.*, 2006) [14]. Lac insects are totally reliant on their host plant, and over four hundred host plants have been identified so far (Sharma 2017) [5].
The most common lac host plants in India are Ber (*Ziziphus mauritiana* Lam.: Rhamnaceae), Kusum (*Schleichera oleosa* Lour: Sapindaceae), and Palas (*Butea monosperma* Lam.: Fabaceae) (Bhatnagar *et al*., 2020) [4].
Amherstia nobilis (Family: Caesalpiniaceae) - Pride of Burma is a tropical tree with exceptionally attractive flowers that is also known as the orchid tree and is innate to Burma. They are an introduced, very rare ornamental tree known as the "queen of the flowering tree" due to their incredibly beautiful and appealing flowers. It can be raised from cuttings and grows to a height of 9-12 m. Nathaniel Wallich introduced the tree to the then Royal Botanical Gardens, Calcutta, after 1849, and then to the rest of India (Roy, 2009) [12]. The presence of natural populations of the lac insect was first observed in Kerala on *A. nobilis* in Thrissur district which is located in the state's central region (Mohanasundaram *et al.*, 2018) [9].
Butea monosperma (Lam.) Tau, of the Fabaceae family, is an important dry deciduous indigenous tree species (Patel *et al.* 2017) [11]. This species' excellent coppicing potential, rich foliage, and resistance to numerous insect pests made it an ideal lac host (yield~40 kg lac per tree), thereby encouraging the rural economy (Lalji *et al*., 2008) [8].
Even though people are involved in lac cultivation, there may be times when these commercial host-trees are not available, and some commercial hosts have a gestation period of 5-10 years (Kusum, ber and palas). In these cases, *F. semialata* is an outstanding lac host plant that can be introduced on a plantation (Alok kumar *et al.*, 2015) [1].
Lac farming and making can only be augmented by using fresh quickly increasing hosts with a short development period, such as *F. semialata* Roxb.ex W. T. Aiton and *F. macrophylla* (Willd) Merr (Das and Kumar, 2013) [3].
Hyblaea puera is the most serious teak defoliator (Lepidoptera: Hyblaeidae) originate among the West Indies and Fiji (Nair, 1988) [7]. Apart from teak, these polyphagous caterpillars feed on a variety of other plants. Their eruptions are common throughout the year in teak plantations of all ages, reducing the quantity and quality of the timber. Chemical pesticides are not recommended for regulatory this pest species because they endanger the forest ecosystem and the biodiversity it supports (Sajeev *et al*., 2007) [13].

Materials and methods
Lac insect collected from Madurai was described as *Kerria maduraiensis* Ahmad & Ramamurthy sp. nov. (Ahmad *et al.*, 2013) [2]. Lac insect was collected again at Madurai in 2021 and confirmed as *K. maduraiensis* by Dr. Thamilarasi and her

team at ICAR-National Institute of Secondary Agriculture, Ranchi, in Jharkhand, India. The collected broodlac insect was then inoculated in four diverse host plants (5grams each): *F semialata*, *F. macrophylla*, *B. monosperma*, and *A nobilis*. These experiments were conducted at the Regional Field Gene Bank (RFGB) at Peechi, Thrissur district, Kerala, India.

Productivity linked parameters

Productivity-related parameters such as preliminary density of settlement, first mortality, sex ratio, and density at crop maturity value were calculated using the methods described below (Mohanasundaram *et al.*, 2016) [10]

Initial density of settlement (number per square cm)

One square centimeter area was chosen at unsystematic (preferably the lower, middle, and upper part of the settlement), and the amount of lac larvae settled was counted from the similar host plant, with the average taken as settlement density.

Initial mortality (%)

The procedure described above was repeated 21 days after broodlac inoculation. The procedure of larval appearance can last up to two weeks in the field. The larvae die from starvation because they are unable to find suitable settlement sites. At this stage, observation provides a factual sign of the number of larvae that have settled and begun feeding.

$$\text{Initial mortality} = \frac{\text{Initial density - Density after 21 days of settlement}}{\text{Initial density}} \times 100$$

Sex ratio (% of male insects)

Larvae cannot be distinguished as males or females at the time of emergence. They can be differentiated into male and female lac insects only after a certain period of growth based on morphological differences where males are elongated and females are round shaped. The process (as in initial settlement density) was repeated to count the number of males and females.

$$\text{Male \%} = \frac{\text{Number of male insects}}{\text{Total number of insects}} \times 100$$

Density at crop maturity (number per square cm)

At crop maturity (appearance of yellow spot), the number of female lac insects that survived (after initial mortality and the emergence of male lac insects) was counted as described above.

Statistical Analysis

The experiment was conducted in Randomized Block Design (RBD). Data were analyzed statistical analysis using techniques of analysis of variance. Biological parameters of *K. maduraiensis* was recorded from different host plants and the data were subjected to analysis of variance (ANOVA) for the significance (P=0.05) using statistical package OP STAT.

Rearing of *H. puera*

H. puera larvae were collected from the lac insect research station at the Kerala Forest Research Institute in Peechi, Thrissur, Kerala, India, and kept in the laboratory at 27±2 °C. The culture started with partially developed larvae collected from the field. Larvae of *H. puera* were reared in insect cages and fed young leaves of *F. semialata* and *F. macrophylla* to confirm the completion of the life cycle.

Results and discussion

The performance of *K. maduraiensis* on various host plants (*F. semialata*, *F. macrophylla*, *B. monosperma*, and *A. nobilis*) at the KSCSTE-KFRI research station in Thrissur, Kerala, is shown in Table 1. When compared to all other host plants, this table clearly shows that the *K. maduraiensis* lac insect performed well on *B. monosperma*.

B. monosperma had the highest mean number of female lac insect (8.40±1.14) as well as the highest mean number of female cell density at crop maturity. On *B. monosperma*, the mean number of deaths was found to be (5.84±4.63). In addition, when compared to other groups, the mean number of male cells in *B. monosperma* plants was very low (Table no.1). According to the findings of this study, the host plant *B. monosperma* is a suitable host for the lac insect *K. maduraiensis* in Kerala.

During the experimental study, it was discovered that the teak defoliator *H. puera* infested the lac insect host plant. Since there were no records of *H. puera* as a pest of *F. semialata*, *H. puera* Cramer is described as a new pest in this study. During the months of October and November 2021, it was observed infesting two lac host plants, *F. semialata* and *F. macrophylla*, at the KFRI's Research Farm.

Following statistical analysis of the collected data, all biological parameters revealed a significant difference between groups at a level of $p<0.05$(Table no.2).

The Teak defoliator (*H. puera*) is a main financial pest of teak in India and additional tropical regions (e.g., Thailand). The pest is a most important concern because it completely defoliates trees throughout the initial part of the rising season and reasons massive timber loss. Teak defoliator eruptions are a yearly incidence in most teak plantations in India, and it is extremely difficult to predict when and where these outbreaks will occur (Chandrasekhar *et al*, 2005) [6].

Conclusion

There is currently no cultivation of lac host plants in South Indian states such as Tamil Nadu, Kerala, and the south region of Karnataka. As a result, the availability of major host plants in this region is extremely limited. The present study finds *B. monosperma* as the best host plant for the lac species *K. maduraiensis*. Hence, in Kerala lac cultivation may be advocated on available *B. monosperma* trees using the lac insect species, *K. maduraiensis.* Apart from the lac cultivation, this study also describes *H. puera* Cramer leaf defoliator as a new pest of two *Flemingia* spp. plants, *F. semialata* and *F. macrophylla.* The introduced *F. semialata* from Ranchi to Kerala has been affected by a variety of insect pests and should be managed using an insect pest management system.

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Table 1: Biological parameters of *K. madurensis* (Mean±SD) on different host plant (*F. semialata, F. macrophylla, B. monosperma* and *A.nobilis*) at KSCSTE-KFRI research station, Thrissur, Kerala.

Plant name	Region	Initial density of settlement m^2)	Settlement after 21 days (cm^2)	Initial mortality	Mean no. of male (cm^2)	Mean no. of female (cm^2)	Density of female cell at crop maturity (cm^2)	Percentage of male (%)
F.semialata	Upper	45.40±1.14	36.00±1.58	20.65±4.33	8.20±1.30	23.20±1.30	2.00±0.71	26.05±3.20
	Middle	38.60±1.14	31.80±1.30	17.55±4.39	6.40±0.89	21.80±1.64	2.80±0.84	22.66±2.40
	Lower	44.40±1.67	37.40±1.52	15.62±5.62	7.80±0.84	21.80±1.79	2.40±0.89	26.37±2.41
F.macrophylla	Upper	59.40±1.14	47.60±1.14	19.86±1.72	11.60±1.52	32.00±2.24	2.60±1.14	26.65±3.80
	Middle	52.00±1.58	47.60±0.89	8.40±2.96	4.00±0.71	35.80±1.48	4.40±0.89	10.06±1.76
	Lower	51.20±1.64	43.60±2.51	14.89±2.56	2.40±0.89	32.60±1.52	3.80±1.48	6.78±2.35
B.monosperma	Upper	75.60±0.89	68.40±1.14	9.51±2.27	7.00±0.71	55.60±1.95	5.80±0.84	11.20±1.33
	Middle	62.40±1.82	57.60±1.14	7.62±3.71	5.60±1.14	51.40±2.88	7.20±1.30	9.85±2.01
	Lower	57.40±1.52	54.00±1.58	5.84±4.63	2.00±0.71	46.20±1.30	8.40±1.14	4.13±1.40
A.nobilis	Upper	34.00±0.71	27.00±0.71	20.60±0.43	8.40±1.14	13.20±1.30	6.00±1.00	38.86±4.03
	Middle	37.00±0.71	29.20±1.30	21.09±2.99	7.60±1.34	17.40±1.34	5.40±0.89	30.40±5.37
	Lower	31.20±2.28	21.60±1.52	30.38±8.25	5.60±1.34	15.20±0.84	5.20±1.30	26.79±5.62

Table 2: Biological parameters of *K. maduraiensis* in different host plants

Name of the lac host plant	Initial settlement density (No/cm^2)	settlement density after 21 days (No/cm^2)	Percentage of male (%)	Density of female cell (No/cm^2)
F. semialata	42.80 (6.62)	35.07 (6.01)	25.03 (5.10)	2.40 (1.84)
F. macrophylla	54.20 (7.43)	46.27 (6.88)	14.49 (3.93)	3.60 (2.13)
B. monosperma	65.13 (8.13)	60.00 (7.81)	8.39 (3.06)	7.13, (2.85)
A. nobilis	34.07 (5.92)	25.93 (5.19)	32.02 (5.75)	5.53 (2.55)
C.D.	0.1	0.09	0.23	0.22
SE(m)	0.032	0.03	0.07	0.07
SE(d)	0.046	0.04	0.10	0.10
C.V.	1.026	1.01	3.64	6.64

*Figures in parentheses are square root √ (X+0.5) transformation values; Means are significant at $p< 0.05$

References

1. Alok Kumar, Jaiswal AK, Singh AK, Yogi RK. (eds.) Advances in Lac Production, Processing, Product Development and Value Addition, ICAR-IINRG, Ranchi, 2015, 1-206.
2. Ayashaa Ahmad, Sharma K K, Ramamurthy, V V, Vidyarthi A S, R. Ramani. Three new species of *Kerria* (Hemiptera: Sternorrhyncha: Coccoidea: Tachardiidae), a redesciption of *K. yunnanensis* Ou & Hong, and a revised key to species of *Kerria*, Zootaxa, 2013, 3620 (4): 518–532.
3. Das R, Kumar A. Lac cultivation and rural livelihood insect host plants of India. In: Kumar, A and Das, R. (edr.) Prospects of scientific lac cultivation in India. Institute of Forest Productivity, 2013, 211-231.
4. Bhatnagar P, Prajapati S, Lodhi B, Bhalawi R, Aarmo BS. Studies on lac host plant occurrence in different agro-climatic zones of Madhya Pradesh. International Journal of Ecology and Environmental Sciences,2020:2(4):197-204.
5. Sharma KK. Lac insects and host plants. In: Omkar (Ed.) Industrial Entomology. Springer, Singapore, 2017, 157-180. https://doi.org/10.1007/978-981-10-3304-9_6.
6. Chandrasekhar N, Sajeev T, Sudheendra Kumar V. Population dynamics of the Teak defoliator (*Hyblaea puera* Cramer) in Nilambur teak plantations using Randomly Amplified Gene Encoding Primers (RAGEP). BMC Ecol,200:5:1. https://doi.org/10.1186/1472-6785-5-1
7. KSS Nair. Kerala Forest Research Institute's tryst with the teak defoliator. Evergreen Newsletter of the Kerala Forest Research Institute, 1988.
8. Lalji S, Ghosh L, Bargali SS, Saxena RR. Response of paddy planted under *Butea monosperma* trees in Chhattisgarh. Int J Ecol Environ Sci,2008:34(1):63-66
9. Mohanasundaram A, Sharma KK, Vaibhav D, Lohot Thamilarasi K, Ghosh J, Ramani R Occurrence of lac insects and their host plants in Tamil Nadu and Kerala royIndian Journal of Entomology,2018:80(4):1351-1358 DoI No.: 10.5958/0974-8172.2018.00288.2
10. Mohanasundaram A, Monobrullah M, Sharma KK, Meena SC, Ramani R. Lac insect and associated fauna - A Practical Manual. ICAR-Indian Institute of Natural Resins and Gums, Ranchi (Jharkhand), India. Bulletin (Technical), 2016, 01-42.
11. Patel G, Dwivedi N, Tripathi IP. Biochemical studies of *B. monosperma* (Palash). Int J Curr Res,2017:9(02):45965-45968.
12. Roy RK. Save these rare ornamental trees. Current Science,2009:97(11):1536-1538.
13. Sajeev TV, Sudheendra kumar VV, Mahiba Helen S, Meera CS, Bindu TN, Bindu KJ. Hybcheck-the biopesticide for managing teak defoliator (*Hyblaea puera* Cramer): An announcement. In Proc. of the Regional workshop on Processing and marketing of teak wood products of planted forests, KFRI, Peechi, Kerala, India, 2007.
14. Sharma KK, Jaiswal AK, Kumar KK. Role of lac culture in biodiversity conservation, Current Science, 2006:91(7):894-898399-40.