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Host plant mediated variations in resin producing efficiency of Indian lac insect, *Kerria lacca* (Kerr) (Homoptera: Coccoidea: Tachardiidae)

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ABSTRACT: The two strains viz. *rangeeni* and *kusmi* of the Indian lac insect, *Kerria lacca* (Kerr) were cultured on different plant species to study their resin producing efficiency; *kusmi* strain performing much better than *rangeeni*. Resin production by individual female lac insect was the highest on *Schleichera oleosa* (22.84 mg) followed by *Acacia auriculiformis* (18.9 mg), *Flemingia macrophylla* (9.43 mg) and *Cucurbita moschata* fruits (6.11 mg) for *kusmi* and *A. auriculiformis* (9.09 mg) followed by *Butea monosperma* (8.76 mg), *F. macrophylla* (7.49 mg) and *C. moschata* fruits (6 mg) for *rangeeni* strain. A strong and positive correlation was recorded between cell size and weight of resin produced. A higher resin weight:cell size ratio of 6.452 in *S. oleosa* for *kusmi* and 2.932 in *A. auriculiformis* for *rangeeni* strain indicated suitability of the host plant for lac cultivation.

KEYWORDS: Indian lac insect, *Kerria lacca*, resin production, host mediated variation

INTRODUCTION

Indian lac insect, *Kerria lacca* (Kerr) is an economically important insect as it secretes resin along with lac dye and wax which find multifarious uses in industrial and household applications and are important export commodities. Although about 400 plant species have been reported to carry lac insects, only some of them can be utilized for lac cultivation. Choice of suitable lac-host plant is therefore an important consideration for profitable cultivation of lac. Besides other economic attributes, size and weight of the female lac cell are important parameters as performance of lac host varieties is evaluated in terms of thickness of the lac encrustation which ultimately determines lac crop yield. However, precise information on effect of host plants on

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the amount of the resin secreted by the lac insect is still lacking. Hence the study was initiated on this aspect of lac insect-host plant interaction.

MATERIALS AND METHODS

Lac culture of *kusmi* strain was maintained on kusum (*Schleichera oleosa*), akashmani (*Acacia auriculiformis*), bhalia (*Flemingia macrophylla*) and pumpkin (*Cucurbita moschata*) fruits; and *rangeeni* strain on palas (*Butea monosperma*), *A. auriculiformis*, *F. macrophylla* and *C. moschata* fruits. *S. oleosa, B. monosperma* and *A. auriculiformis* are tree species identified in the field and were pruned before inoculation of lac insect as per recommended schedule of lac cultivation. *F. macrophylla,* a small bushy plant, was grown in earthen pots under semi-field condition; while ripened fruits of *C. moschata* were kept in a wooden box having glass in front and metal sieve on other sides. The inoculation of lac insect was done in June-July. The *rangeeni* crop matured in October-November and the *kusmi* in January-February.

The study was confined to female lac insects as the males are known to contribute very little towards resin production. As the lac larvae tend to settle in close proximity, lac secreted by the insects coalesces to form a continuous encrustation. Therefore, the cultures were manually thinned out and isolated individual female lac insect cells were collected at crop maturity for assessing lac production. Each cell was kept separately in five-ml glass vial for about a month till all the nymphs emerged and the lac insect inside became dead and dry. The weight of each intact cell, vertical diameter and horizontal diameter were recorded. The mean of horizontal and vertical diameters was treated as the index of cell size. The cells were broken open and the resin was separated from the insect body and weighed to determine size / body weight ratio. The significance of the variations in the data was tested by DMRT.

RESULTS AND DISCUSSION

Average mean diameter of a cell in *kusmi* strain was 3.02, 3.16, 3.5 and 3.54 mm on *C. moschata*, *F. macrophylla*, *A. auriculiformis*, and *S. oleosa*, respectively (Table 1). Resin produced by individual female lac cell varied significantly. It ranged between 6.11 mg on *C. moschata* fruits to 22.84 mg on *S. oleosa.* Resin produced per unit size of the cell was the highest (6.452) on *S. oleosa* followed by *A. auriculiformis* (5.4), *F. macrophylla* (2.984) and *C. moschata* (2.023). Average resin production on different lac hosts in ascending order was *C. moschata* fruits $<$ *F. macrophylla*, $<$ *A. auriculiformis* $=$ *S. oleosa.* Very high intra-strain variations were observed in resin producing efficiency of lac insect even when cultured on the same host plant.

Average mean diameter of a cell in *rangeeni* strain was 3.1, 3.17, 3.19 and 3.22 mm respectively on *A. auriculiformis, F. macrophylla, C. moschata*, and *B. monosperma* (Table 1). Resin produced per unit size of the cell was the highest (2.932) on *A. auriculiformis*, followed by *B. monosperma* (2.72), *F. macrophylla* (2.363) and *C. moschata* (1.881). Resin produced by individual female lac cell varied significantly. It ranged between 6 mg on *C. moschata* fruits to 9.09 mg on *A. auriculiformis.* Average

TABLE 1. Size and weight of lac cell of *Kerria lacca* grown on different host-plants.

Host	Cell diameter (mm)		Cell weight (mg)		Resin weight (mg)	
	A	B	A	B	A	B
Schleichera oleosa (kusum)	3.54[a]	–	25.80[a]	–	22.84[a]	–
Butea monosperma (palas)	–	3.22[a]	–	10.55[a]	–	8.76[a]
Acacia auriculiformis (akashmani)	3.50[a]	3.10[a]	21.74[b]	10.94[a]	18.90[b]	9.09[a]
Flemingia macrophylla (bhalia)	3.16[b]	3.17[a]	10.99[c]	8.74[b]	9.43[c]	7.49[b]
Cucurbita moschata (pumpkin fruits)	3.02[b]	3.19[a]	8.08[d]	8.91[b]	6.11[d]	6.00[c]
Average	3.40	3.17	19.51	10.01	16.96	8.07

A, *kusmi*; B, *rangeeni*

* Values in each column indicated by the same letter are on par (DMRT).

resin production on different lac hosts in ascending order was *C. moschata* fruits > *F. macrophylla* > *B. monosperma* > *A. auriculiformis*.

Average resin produced by cells of *kusmi* strain (16.96 mg) is more than twice that of the *rangeeni* cells (8.07 mg). Resin produced per unit size of the cell is more in *kusmi* (4.99 mg/mm) than *rangeeni* strain (2.55 mg/mm). Horizontal diameter of the cell was more than vertical diameter confirming the globular shape of the cell. Weight of the same size cell per female on different host plants showed significant differences demonstrating the effect of host on resin productivity of the insect (Figs. 1 and 2). A strong and positive correlation was recorded between size of the cell and the resin produced on all the host plants for both the strains. Higher values of coefficient of regression in *S. oleosa* and *A. auriculiformis* for *kusmi* strain and *B. monosperma* in *rangeeni* strain corroborate the fact that a good lac host allows full manifestation of the resin producing potential of the lac insect.

Resin producing efficiency of lac insects is high on tree hosts in comparison to *F. macrophylla* (a shrub) and the pumpkin fruit. Lac insect feeds on phloem sap of the plant (Krishnaswami *et al.*, 1964). Sreenivasaya (1924) has described that sucking of phloem sap in lac insects is passive which as a function of phloem turgor has a substantial role in the supply of food to the insects. Auclair (1963) has reported that the exudation rate of phloem sap through excised stylets in aphids is about an order of magnitude lower in herbaceous plants relative to woody plants. Considering the passive feeding habit of lac insect, higher turgor pressure may lead to greater food ingestion and thus higher resin output and vice-versa. Kloft (1977) has also

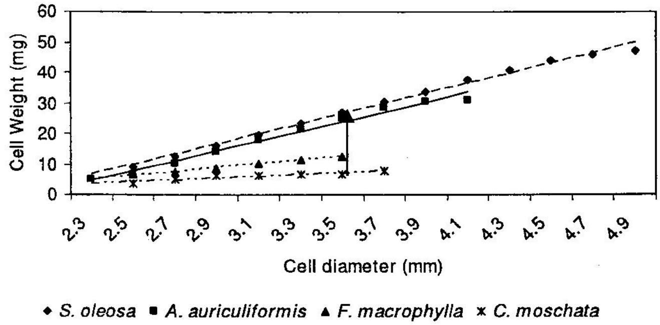

FIGURE 1. Resin productivity as affected by host-plant in *kusmi* strain *Kerria lacca* during winter season crop. Arrow indicates the difference in weight of resin secreted on different host-plants by female lac insect of the same size ($R^2 = 0.4152$ in *C. moschata* to 0.9499 in *S. oleosa*)

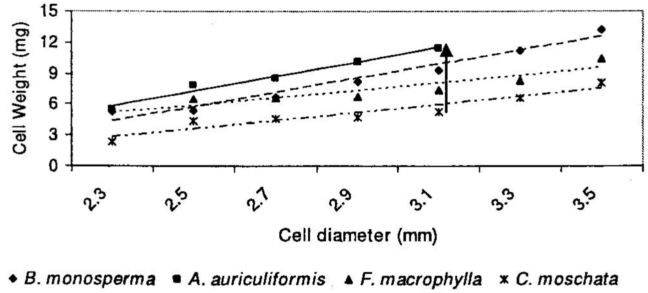

FIGURE 2. Resin productivity as affected by host-plant in *rangeeni* strain of*Kerria lacca* during rainy season crop. Arrow indicates the difference in weight of resin secreted on different host-plants by female lac insect of the same size ($R^2 = 0.6774$ in *F. macrophylla* to 0.899 in *B. monosperma*)

reported that insects feeding on non-host plants suddenly cease feeding, withdraw their stylets and leave the plant. But in case of lac insects, once they are settled at one place they do not move. Therefore, it is likely that by feeding on phloem of a less suitable host, lac insects do not escape ingesting or coming into contact with plant's defensive chemicals, and so their ability to detoxify them, or avoid including their production may result in varying yield of lac on different species of the plants and sometimes between different genotypes of the same host-plant. Edmund and Alstad (1978) while studying *Nuculaspis californica* strongly suggested that deviation in susceptibility of a host-plant species is caused by intra specific variation in the host-plant defence. Lac insects have been found to be very specific in manifestation of their biological attributes not only to the host species, specific varieties and even to individual phenotype of host-plants (Mishra *et al.*, 1999; Srinivasan, 1956) but also to locality and season of cultivation.

Quality and quantity of amino acids present in the anal fluid (honeydew) of the lac insect, *K. lacca* differs when grown on *Moghania* (= *Flemingia*) *macrophylla* and three species of *Ficus viz. F. glomerata, F. indica* and *F. religiosa* (Haque, 1984), which points to the difference in nutritional composition of the host plants. Therefore, it is imperative that nutrient requirement of the lac insect should be managed properly through plant-hosts for better lac yield. As the lac insects are passive feeders, manipulating turgor pressure for increased feeding in the host-plant, especially the bushy hosts may help improve lac resin yield.

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