Laboratory rearing of *Kerria lacca* (Kerr) (Homoptera: Coccoidea: Tachardiidae) on the fruits of pumpkin, *Cucurbita moschata*

K. Krishan Sharma

Division of Entomology, Indian Lac Research Institute, Namkum, Ranchi 834 010, India

The Indian lac insect, better known for the commercial value of its secretions such as resin, wax and dye, requires plant hosts for its propagation. Attempts to rear it on synthetic diet have not been successful. For the first time, we have reared lac insects on fruits of pumpkin in the laboratory. This would facilitate many experiments that were hitherto not easy.

THE Indian lac insect *Kerria lacca* (Kerr), a natural parasite on certain trees, is purposely cultivated for commercial value of its secretion. India produces approximately 17,000 m.t. of lac per annum (1986–1990 average) and 80–85% of that is exported in one form or another. Being an export-oriented commodity, lac has considerable foreign exchange value. Besides, it constitutes about 30% of total income budget of more than three million tribal families engaged in lac cultivation. The lac insect is phyto-succivorous and sedentary in habit and thus, requires a plant host for maintenance of its cultures.

Of the large assemblage of plant species recorded from India those of major importance are mostly tree species and a few are wild as well as cultivated plants[1]. Attempts to rear lac insects on synthetic diet in the laboratory have not met with the required success so far[2,3] and as such most of the research till now has been conducted rather under field conditions. Sheer physical size of the host plant coupled with sedentary nature of the lac insect poses problems in day-to-day observations and routine operations of experiments. Moreover, pests of host plant inflict severe damage to it and devitalize it which indirectly affects the lac insect performance. The proper management of host plant, thus becomes equally important involving considerable time and energy. A need was felt to rear lac insect away from plant which would facilitate laboratory studies.

Reports are available on cucurbit fruits being used to rear insects on them[4,5]. Pumpkin which has a thick rind and can be stored over quite a long period of time seemed to hold good promise as lac insect completes its life cycle in 4–8 months depending upon the season of propagation and the strain used.

The propagation of lac insects was carried out on pumpkins devoid of any injury and having a small stalk which made the handling easy. Any slight injury resulting out of handling was sealed with wax to prevent desiccation and attack of pathogens. The brood lac (gravid, mature female lac insects from which larvae of new generation are yet to emerge) taken directly from the field was placed over the upper part of pumpkins which were hung in a cage to avoid attack of parasites and predators. The cage used was a rectangular wooden box (105 cm × 45 cm × 30 cm) fixed with fine mesh wire netting on the lid and on the front and back sides of it to ensure free circulation of air. Some cotton was wrapped around the stalk of pumpkins to prevent straying away of emerged larvae moving in search of feeding site. Larvae being of gregarious nature settled in close proximity (Figure 1). Once the emergence was over, brood lac was removed. After one month of settlement the larvae were regularly sprayed with 0.1% solution of a fungicide, Dithane M-45, at fortnightly intervals as honey-dew secreted by the feeding larvae attracts fungus which kills them by blocking the respiratory pores.

Larvae, though well settled on fresh, green, immature pumpkins died within 2–5 days of settlement, showing no sign of feeding. However, the secretion of white wax filaments on ripened (stored for some time after harvesting) assured that the larvae had started feeding (Figure 2).

Both the strains of lac insect, *kusmi* (producing superior quality of lac, grown on *kusum*, *Schleichera oleosa* or on other host plants taking brood from *kusum*) as well as *rangeeni* (inferior to *kusmi*, grown on the host plants other than *kusum*, taking brood lac neither from *kusum* nor from the progeny of *kusmi* brood) were propagated in rainy season on the pumpkins which completed their respective life cycle normally (Table 1).

The finding is of great applied significance as it will: (i) facilitate ascertaining the specific nutritional requirements of lac insects which may be incorporated in the plant hosts for bringing about desired improvements in

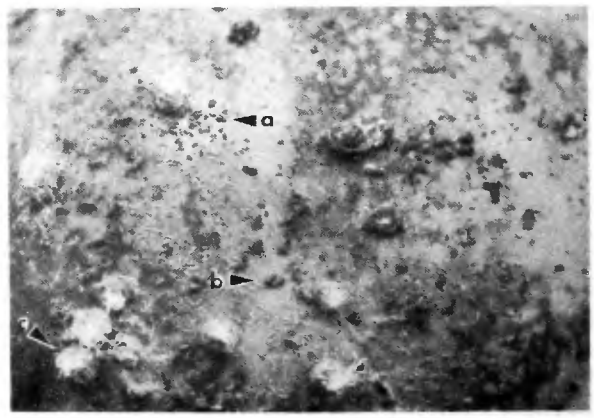

Figure 1. Lac insects on pumpkin (enlarged) showing (a) freshly settled larvae, (b) cell of male lac insect from which male has emerged, (c) single mature lac insect female.

Figure 2. Mature lac insect females on pumpkin secreting white wax filaments.

Table 1. Various attributes of lac insect life cycle showing normal behaviour on pumpkin.

Strain used	Date of propagation	Male emergence (after settlement)	Total time taken (in days) to mature	Mean	No. of insects studied
Kusmi	14 July '90	7–8 weeks	142–160	153	83
Rangeeni	29 June '90	6–7 weeks	120–137	124	94

quality and quantity of lac. Another secondary objective of such study is to artificially rear lac insects on synthetic diet in laboratory to conduct certain studies on genetical, physiological and toxicological aspects of lac insect and its major predators; (ii) make ecological studies in controlled physical environment more convenient; (iii) make lac insect amenable to certain experimentation techniques; (iv) save much of labour and money as it requires practically nothing towards its maintenance.

Efforts are being made at this institute to standardize the rearing technique for further studies.

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Construction of a gene bank of *Cicer-Rhizobium*

S. P. S. Khanuja

Biotechnology Centre, Indian Agricultural Research Institute, New Delhi 110 012, India

A gene bank of *Cicer-Rhizobium* has been constructed using a broad host range conjugally transferable cosmid vector pLAFR1. The random analysis of clones from the gene bank showed average insert size of 21.1 kb and a high degree of randomness. As an initial test, clones were isolated carrying *str* gene of strain Rcd301 (Str^R) using F75 (Str^S) as the recipient. The frequency of transfer of clones of the bank from *E. coli* to *Cicer-Rhizobium* was 4×10^{-4} and of Str^R transconjugants was 1.2×10^{-6} per recipient cell. The maintenance of cosmid clones was confirmed by growing transconjugants without selection and also passing through chickpea nodules.

CICER-RHIZOBIUM is the soil bacterium that forms symbiotic nodules on the roots of chickpea (*Cicer arietinum*) plants and fixes atmospheric nitrogen there. Cross inoculation group specificity studies on chickpea and its nodule bacteria have shown *Cicer-Rhizobium* as a distinct group than known groups of alfalfa, clover, pea, bean, soybean, lupin-lotus and cowpea miscellany[1]. India is the premier chickpea-growing country accounting for 76% of the total area and production in the world[2]. Within the country, chickpea is the predominant pulse crop covering 30% of the area and 37% of the production of all pulses grown. In spite of this fact India has been harvesting only one third of the productivity potential at the national level[3].

Developing effective and competitive strains of *Rhizobium* as a biofertilizer is a desirable step to improve the pulse production in general at low cost[4]. Present day varieties of chickpea are adapted for marginal conditions, including low soil fertility, minimum agronomic inputs and poor crop management. Under field conditions[5] seed inoculation with chickpea *Rhizobium* has demonstrated a significant increase in grain yield of chickpea from 4 to 67%. Understanding the genetics of symbiotic and adaptive functions in chickpea *Rhizobium* would be, therefore, a pre-requisite for its directed improvement through genetic manipulations and recombinant DNA approach. Such studies would be facilitated if the complete gene bank of an effective *Rhizobium* strain is available. A cosmid gene bank of a wild type *Cicer-Rhizobium* strain Rcd301 was constructed on a broad host range cosmid vector pLAFR1[6]. The construction of gene bank and its use in isolation of recombinant cosmids containing Str^R gene is described.

Bacterial strains and growth media. Strains of *E. coli* and *Rhizobium* used in the study are listed in Table 1.