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PERFORMANCE OF LAC INSECT, *KERRIA LACCA* KERR IN CONVENTIONAL AND NON-CONVENTIONAL CULTIVATION AROUND SIMILIPAL BIOSPHERE RESERVE, ODISHA, INDIA

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ABSTRACT
Lac is the only resin of animal origin that is the secretion of a tiny scale insect, *Kerria lacca* Kerr. It thrives on the tender shoots of its host plants, like Palas (*Butea monosperma*) and Kusum (*Schleichera oleosa*). These primary host plants are plently available in different zones (buffer and peripheral) of the Similipal Biosphere Reserve (SBR) where people (mostly tribals) are cultivating lac in a conventional way. A comparison between non-conventional (scientific) and conventional (tradional) methods of lac cultivation at SBR shows 25-35% more resin production in former method. The resin production is also more in its two strains (Kusmi on Kusum and Rangeeni on Palas) in buffer zone than that of the peripheral zone. Further, the result shows that resin production is greater in Kusmi strain compared to Rangeeni strain.

INTRODUCTION

Lac is one of the most valuable gifts of nature to man. It is the only resin of animal origin, being actually the secretion of a tiny scale insect, *Kerria lacca* Kerr (belongs to the family Tachardiidae (Kerriidae), superfamily Coccoidea of the order Homoptera). It basically yields three useful materials: resin, dye and wax. Resin is commonly known as lac found in market as shellac or seedlac or button lac. Lac has been a highly valued commodity throughout the ages all-over the world. In modern times also, despite the availability of many a synthetic competitor, it occupies a place of importance in various arts and crafts and it is expected that systematic research will help in maintaining that place in future. Its cultivation also does not require much capital which attracts the poor lac cultivators. But they are cultivating it in a conventional (traditional) way since thousands of year ago. Though vast forest areas abound host plants of lac in India, no one is employing non-conventional (scientific) method for cultivation lac developed and designed by Indian Institute of Natural Resins and Gums (previous Indian Lac Research Institute) Namkum, Ranchi, Jharkhand. This is only the pioneer institute in the world where extensive research is going on to maximize the lac production (Bhattacharya, 2007). Further, lac (resin) production is greatly influenced by the climatological factors, like temperature, rainfall, humidity, wind etc. (Watt, 1901; Lindsay and Harlow, 1921; Nicholson, 1925; Bhagat and Mishra, 2002). Out of all these factors temperature is most important (Srinivasan, 1956; Mishra *et al.*, 1999a, b; Bhagat and Mishra, 2002; Sharma, 2007). Lac is produced by lac insect on its major host plants like Kusum, Palas and Ber. The lac insect of Kusum tree is usually called as Kusmi strain and on Palas tree as Rangeeni strain. Both the strains have different crops. And the Kusmi strain is superior to Rangeeni strain (Kumar *et al.*, 2002; Sharma and Jaiswal**,** 2002). The poor tribal rearers are cultivating lac on its host plants which are plentily available in and around Similipal Biosphere Reserve (SBR), Mayurbhanj, Odisha in their conventional way. For economically effective lac cultivation the study of productivity of lac in this region is most essential for the betterment of tribal people of Mayurbhanj district and to meet the growing demand for natural lac. In order to achieve this goal a work has been undertaken to study the productivity of lac insect *Kerria lacca* (Kerr) on its primary (major) host plants, like Palas (*Butea monosperma*) and Kusum (*Schleichera oleosa*) in buffer and peripheral zones of SBR by employing non-conventional (scientific) way of lac cultivation. Simultaneously observation was also made on the productivity of lac through conventional way. So that, a comparison will be made between these two methods for lac productivity. The cultivation in buffer and peripheral zones was studied to know the effect of temperature on the performance of lac insect.

MATERIALS AND METHODS

Study area

The study was conducted in Similipal Biosphere Reserve, Mayurbhanj, Odisha during 200-09. The land is undulating and filled with valley forest, plain forest and hilly forest. The altitude varies from 50 to 1,150 m. ASL. The ecosystem and

the climatological parameters vary in an altitudinal gradient. Moreover, the selections of study sites in the Biosphere Reserve were done keeping in the mind the availability of lac hosts in the different ecoclimatic pockets. Furthermore, survey was taken up in two different zones of SBR with having diversified forest types. These places were Jadida, Jadunathpur (100-200 m ASL) and Chakidi (200-300 m ASL) in peripheral zone, 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 and Kusum of lac insects are found were taken as study sites. Assistance was taken from the staffs of Forest Department, Government of Odisha. The officials of Nuclear Broodlac Farm, Chakidi and skilled rearers were also used to help in the survey. The geophysiography of study sites were undertaken keeping in the view of the altitude of natural blocks, forest types and zones of SBR. Culture method was adopted as per Indian Institute of Natural Resins and Gums (IINRG), Namkum, Ranchi and from scientific publications. It will not be out of context to mentioned here that the research publications on lac cultivation are mostly from IINRG (previously ILRI), Namkum, Ranchi (ILRI Ann. Rep., 2005-06). Temperature, humidity, rainfall, duration of sunshine hours per month were observed daily at the different locations. Month and season-wise values of the above parameters were observed.

Cultivation of lac

Indian lac insect is known to have two distinct strains 'Kusmi' and 'Rangeeni'. The Kusmi strain is grown on Kusum or on other alternate host plants using Kusmi broodlac and the crops are (i) Jethwi (June/July) and (ii) Aghani (Jan. /Feb.). The Rangeeni strain thrives on host plants like Palas and it has also two crops; they are (i) Katki (Oct. /Nov.) and (ii) Baisakhi (June/July). Pruning of host trees and method of inoculation (Kumar et al., 2002; Sharma, 2007 and Sharma et al., 2007), and application of pesticides, forecast of larval emergence and crop harvesting (Sharma and Jaiswal, 2002) were done in time. Pruning of trees were done 6 and 12 months before inoculation of lac insect for both Palas and Kusum plant, respectively.

Extraction of resin

To measure the weight of resin (per cell) sticklacs collected from fields were weighed and scraped, water soluble materials were removed by water wash, left for air dry and then grinded to get fine products. Resin was extracted by alcoholic solvent extraction method, *i.e.,* dissolved in 90% alcohol (1:4 weight/volume). When it was made into solution, insoluble residues were allowed to settle; the solution was then filtered and was kept open for evaporation of alcohol (Bose *et al*., 1963). Weight of resin (15-20 % wax and other residues) was measured by physical monopan balance. To calculate the weight of resin (per cell), resin produced/cm^2 was divided by number of female cells/ cm^2 area.

Resin productivity using conventional method

Inhabitants mostly tribals in and around SBR are cultivating/ harvesting lac in a conventional way on the primary as well as on secondary host plants. For example, it was observed that pruning is rare and whenever there is pruning proper duration is not maintained for inoculation. Many times they did not collect sticklacs for seed purpose. They collect phunki after emergence of larvae so that crawlers are settled in old branches. Therefore, a comparison was made between non-conventional method (present study) and conventional method of lac (resin) productivity in SBR. For comparison, the winter crop (Aghani) of Kusmi strain on Kusum tree and the summer crop (Baisakhi) of Rangeeni strain on Palas tree in 5 places each were compared between two methods of lac cultivation in 2008-09. Because Aghani crop of Kusmi strain and Baisakhi of Rangeeni strain are the main crops contribute about 90% of lac production; remaining 10% is contributed by Jethwi and Katki crops (Sharma and Jaiswal, 2002). So Kusum and Palas plants were taken for the study.

Statistical analysis

Paired t-test was used to find out the level of significance between peripheral and buffer zones of same crop, and resin production between conventional and non-conventional methods; and Fisher t- test for same zones in different crops of respective strain on two host plants, like Kusum and Palas (Chainy *et al*., 2008).

RESULTS

Weight of resin produced by female of *K. lacca* in non-conventional method of cultivation To know whether there is any significant difference in the weight of resin produced by female between different crops of the same zone and same strain, and also between two zones of the same crop, the paired t-test was employed between two different zones of same crops and Fisher t-test for same zones of different crops.

The weight of resin (mg/cell) in peripheral zone of summer crop (Jethwi) (20.50) was significantly higher ($p < 0.02$) than that of the winter crop (Aghani) (18.00) of Kusmi strain on Kusum plant. In buffer zone winter crop (24.52) was more than summer crop (23.32) but there was no significant difference between them (Table 1). The summer crop (Baisakhi) (16.31) was significantly higher ($p<0.001$) than that of the rainy crop (Katki) (6.00) in the Rangeeni strain of Palas plant in peripheral zone of SBR. For the buffer zone the summer crop (19.11) was significantly higher ($p < 0.001$) than that of the rainy crop (6.50) of Rangeeni strain in Palas plant (Table 1).

The statistical analyses on winter crop (Aghani) of Kusmi strain on Kusum plant revealed that buffer zone (24.52) was significantly higher ($p < 0.01$) than that of the peripheral zone (18.00) (Table 1). In Jethwi crop the buffer zone (23.32) was more than the peripheral zone (20.50) but there was no significant difference between them. For both Katki and Baisakhi crops of Rangeeni strain on Palas plant in buffer zone (6.50, 19.11) it were more than the peripheral zone (6.00, 16.31) but there was no significant difference between them (Table 1).

Comparison of resin productivity using non-conventional and conventional methods

In conventional method the average resin produced by female insect in case of winter crop of Kusmi strain on Kusum plant was 12.45 mg and 14.87 mg in peripheral and buffer zones, respectively (Table 1). Similarly, the resin output in summer crop of Rangeeni strain on Palas plant was 10.31mg and

Table 1: Weight (mg/cell) of resin produced by female of *Kerria lacca* (Kerr) on various host plants in different zones of SBR on non-conventional and non-conventional methods of cultivation in 2008-09. Data are Mean ± SD of 5 places

Host plant	Strain	Crop	Zone	Resin productivity (Mean ± SD) non-conventional method	conventional method
Schleichera oleosa (Kusum)	Kusmi	Aghani (winter)	Peripheral	18.00 ± 0.73#	12.45 ± 0.46
			Buffer	24.52 ± 03.21a, #	14.87 ± 0.96
		Jethwi (summer)	Peripheral	20.50 ± 01.69*	-
			Buffer	23.32 ± 0.74	-
Butea monosperma (Palas)	Rangeeni	Katki (rainy)	Peripheral	06.00 ± 01.05	-
			Buffer	06.50 ± 01.07	-
		Baisakhi (summer)	Peripheral	16.31 ± 01.93* *, #	10.31 ± 0.57
			Buffer	19.11 ± 01.47* *, #	13.12 ± 0.72

*$p < 0.02$ and **$p < 0.001$ in comparison to different crops of same zone of the respective strain for different host plants. a$p < 0.01$ in comparison to peripheral zone of same crop of the respective strain for different host plants. #$p < 0.01$ in comparison to conventional method of same zone of same crop of the respective strain for different host plants

13.12mg in peripheral and buffer zones, respectively. The resin output in this method was found to be 25-35 % less than that of the non-conventional method of lac culture (Table 1).

The non-conventional method of resin production in Aghani crop of Kusmi strain on Kusum plant in peripheral zone was significantly higher ($p < 0.01$) than the conventional method. Similar trend ($p < 0.01$) was also found in buffer zone. In case of Baisakhi crop of Rangeeni strain on Palas plant in peripheral zone, the non-conventional method of resin production was significantly higher ($p < 0.01$) than the conventional method of cultivation. Similar trend ($p < 0.01$) was also found in buffer zone (Table 1).

DISCUSSION

The tiny lac insect *Kerria lacca* provides not only livelihood to a large number of poor tribal people (Sohail, 1998) but it has become a part of civilization. Lac cultivation also helps in conserving vast stretches of forests and biodiversity associated with lac insect complex (Sharma *et al*., 2006; ILRI Ann. Rep., 2005-06, 2006-07; IINRG Ann. Rep., 2007-08; Dey *et al*., 2010; Mohanta *et al*., 2012 a, b). Resin productivity of buffer zone was more than the peripheral zone both in Kusmi and Rangeeni strains. This may be due to average higher temperature (35.20 ºC) in peripheral zone than buffer zone (31.24 ºC). It implies that cold climate and higher rain fall favours more lac production. But when mean of peripheral and buffer zone was compaired crop-wise, Aghani was little better (21.26 mg) than Jethwi crop (21.91 mg) in Kusmi strain on Kusum Plant. Similarly, the mean of peripheral and buffer zone in Rangeeni strain of Baisakhi crop (17.71mg) was more than Katki crop (6.25) on Palas tree (Table 1).

According to the data of resin production in conventional method during the year 2008-09 (Table 1) Aghani crop of Kusmi strain on Kusum plant has better result (13.66 mg; mean of peripheral and buffer zones) than that of the Baisakhi crop (11.71 mg; mean of peripheral and buffer zones) of Rangeeni strain on Palas plant. Yield of 25-30% more resin by non-conventional method of lac cultivation over conventional method indicates that the rearers will be benifitted economically following non-conventional method. The present result on production of resin among two strains showed that resin production was more in Kusmi strain than that of the Rangeeni strain. It has been reported that Aghani crop of Kusmi strain and Baisakhi of Rangeeni strain are main crops contributed about 90% of lac production. Kusmi crop is considered superior resin, because of lighter colour of resin and it fetches better price in Indian market (Sharma and Jaiswal, 2002). So potential of more resin production by Kusmi strain at SBR is a gift of the nature.

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