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Recent advances in lac production technologies

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Abstract

Lac is a source of nature resin of insect origin. Due to its few unique characteristics, it has assumed a definite place in industry. For sustained lac production in the country, there is need for developing farmer friendly technologies in one hand and dissemination of the same on the other hand. The Institute has already developed some important technologies, which are being transferred to farmers' field. Screening and isolating *Flemingia semialata* as a bushy lac host is considered to be one of the salient achievements. Lac cultivation with this host can be integrated with general agriculture and farmer can reduce gestation period of hosts and drudgery as well. Crop protection against lac predators and pests is another field where insecticides like ethofenprox, fipronil, indoxacarb etc. have been screened out along with dose and frequency of application in lac production system. Development of agronomic practices suitable for lac culture is yet another field which this Institute has addressed. Crop geometry, fertilizer recommendations, weed control methodology, effect of different abiotic factors, host-insect interaction of different host plants under lac cultivation are some of the important factors which have been optimized for field condition.

Keywords: Crop geometry, *Flemingia semialata*, fertilizer recommendations

Introduction

Lac is one of the important sources of natural resin, wax and dye which is produced by a specific group of scale insects called lac insect (Homoptera: Tachardiidae). The resinous protective hard shell, secreted around the insect's soft body throughout its development, is the only natural resin of animal origin. The Indian lac insect, *Kerria lacca* (Kerr) survives on selected host trees e.g. *kusum*, *ber*, *palas* etc.

Traditionally, lac resin is used in bangle industry. It can produce thin film, therefore used in varnish making. Lacquer, a product derived from lac, is useful in realizing an elegant sheen to painted wooden products. In recent years, lac has been used in coating pharmaceutical products for absorption in the hind gut and not in the stomach of human. The water soluble lac dye has been used as a cosmetic in human decoration, for dyeing wool and silk and to stain leather. Lac wax is used in coating fresh fruits of apple and orange, so that their shelf-life can be increased. Aleuritic acid, the principal material in the resin, is extensively used as a starter in perfumery industry.

In India, lac is cultivated in 50 districts spread over 12 states. A total of 16978 tons of raw lac was produced in 2014-15 (Yogi *et al* 2017). In Jharkhand, lac cultivation constitutes the second most important source of rural family income. Due to its diversified uses, demand of lac is increasing globally and price of the commodity is also in its increasing trend.

In India lac is cultivated since time immemorial. Its cultivation is gaining momentum among the farmers because of the profitability. Process of pruning, inoculation, brood rate etc is quite old techniques. Research activities taken up recently has generated information which is helping to increase profit more and more and at the same time confidence of farmer for lac cultivation is increasing day by day. In the next few para we will be dealing with potential of some of the recently developed technologies.

Technological details

All the promising lac hosts present are big trees which take 5-15 years to come before attaining inoculable stage. It was thought that lac cultivation could be easier and even integrated to general agriculture if some quick growing bushy host would be available. With this objective, few germplines of *Flemingia* spp were brought from ICRISAT, Hyderabad for testing its potential as lac host. Out of ten germplines, *F. semialata* emerged to be outstanding in lac production (Kumar *et al*, 1998). It is a member of family Leguminosae. Multiplication is done through seed. Flowering takes place in the month of November and seed matures in March/April. Lac cultivation starts one year after transplanting. It is planted in paired row system and 8200 plants can be accommodated in a hectare.

Mainly, winter season *kusmi* lac is cultivated on this host. However, summer season lac can also be cultivated with irrigation facility. The host is much more succulent than other bushy hosts and dry matter percent ranges between 24-29 percent (Ghosal *et al*, 2016). Therefore, it has proved its suitability as a good lac host. It responds very well to fertilizer application. A dose of 25-5-30 g N, P₂O₅ and K₂O and 1050 kg lime/ha is recommended for acid soils of Jharkhand. Fertilization can increase sticklac production up to 69 percent. A very good extension work has been done for its dissemination and presently it is being cultivated on 10 states. *Ber* is very much preferred lac host due to its easy availability in villages. Earlier, farmers used to cultivate *rangeeni* lac on *ber* trees. Therefore, pruning time used to be April/ May. The Institute has made some technological intervention and made the *ber* trees much more useful and profiteering by growing *kusmi* lac on it with better yield and quality. Since *kusmi* lac cultivation is done in Jun/ July, the Institute has modified pruning time (Feb/ Mar in place of April/ May) for the same. It has received a lot of appreciation and has been adopted by farmers at large scale. With this intervention farmers are able to grow broodlac for *kusmi* lac, which is much better in quality, besides having higher market price. Farmers are able to increase its farm income at least two times more than *rangeeni* cultivation (Mishra *et al*, 2000).

Flemingia semialata is a bushy host; therefore lac inoculation should be done very carefully. Normally, lac is inoculated @ 35 cm settlement per metre shoot length. Late *kusmi* variety of lac insect put much stress on *semialata* plants and as a result both the broodlac produced and the host plant suffers mortality. Therefore, early *kusmi* breed cultivation on *semialata* is recommended for sustainable lac production (Sharma and Ramani, 2010). Forty four percent increase in yield of per meter broodlac and 30.89% increase in sticklac can be expected along with no detachment of broodlac from the stem when lac cultivation is done as per recommendations.

Lac production is influenced positively due to prophylactic spray of fungicide. So far, only one fungicide i.e. carbendazim has been tested for the purpose. Repeated use of a single pesticide can induce resistance of the pathogen. Rigorous screening of fungicide was done and hexaconazole and chlorothalonil emerged to be safe for lac culture. Dose and frequency of spray was recommended for farmers. Three sprays at 60, 90 and 120 days after inoculation performed the best. Recommended doses for two fungicides were 0.5 ml/ litre and 1.0 g/ litre respectively. Yield increase due to use of hexaconazole could be 38-56 per cent higher over control. The same value for chlorothalonil may be expected to range 18-47 per cent higher.

Eublemma amabilis, *Pseudohypatopa pulveria* and *Chrysopa medestis* are three major predators of lac insect. All pesticides are not suitable to lac crop equally. Therefore, a proper screening is required for proper pest management. Ethofenprox, indoxacarb, fipronil, spinosad, chlorantraniliprole, emamectin benzoate, novaleuron have been screened out and found safe on lac insect and effective in superseding the population of insect predators and parasitoids of lac insect. First three are very much effective for lac production system. Three sprays are recommended for any one of the pesticides. Recommended dose of the pesticides are 0.02% for ethofenprox and 0.007% each for fipronil and indoxacarb.

Lac hosts in majority of cases are found in barren lands. As a result tree health in general is not satisfactory. Fertilizer

application on lac hosts has implication in two ways-i.e. in context to tree growth perspective and in the perspective of lac production. All the plant nutrients in recommended dose will increase/ sustain tree growth, but all nutrients in a specific dose may not contribute to lac production. A detailed study on soil fertility done in this Institute ascertained about the nutrients and its doses at which it gives satisfactory lac production. Findings suggested that lime application and potassium are beneficial for lac cultivation. Unfertilized trees under continuous *kusmi* lac cultivation suffer mortality and bad tree health. Tree biomass continues to decrease @ 800 g/year/ tree. In some cases, tree mortality starts after few years. The technology developed at this Institute ensures no mortality of host i.e. assured sustainability. The technology checks host mortality and increase lac yield. Therefore, sustainable lac production on *ber* is possible on one hand and increased income will give more economic sufficiency. It will address both social and environmental issues. Application of 200 g nitrogen, 150 g of phosphorus & 500 g potassium and liming @ 2.25 kg/tree is recommended for *kusmi* lac production on established plantation. Lac production can be expected to increase by 34%. (Ghosal, 2012).

Ventilation and penetration of sunshine within tree canopy are important factors for *kusmi* lac production in winter season. Depending upon the type of *ber* trees, proportion of thin shoot (basal diameter < 7 mm in July) varies from 22 to 42 percent. Therefore, light transmission ratio also varies from 18 to 45 percent. Assimilate supplying capacity of thin shoots is limited. Therefore, huge mortality of lac is observed on such shoots (58- 75 percent). Among the four types of *ber* trees, lac yield performance is the best with roof type tree with brood produce/ brood used ratio followed by erect and semi erect types; bushy type is the poorest performer where brood yield/brood used ratio is observed to be very low (0.99). High lac mortality is frequently observed on thin shoots, poor ventilation and under condition of poor sunshine availability, usually found under bushy type tree canopy (Ghosal and Mishra, 2009). As a consequence production of lac is less on such trees. Shoots of higher diameter can fulfill the need of lac insect in a better way in case of erect type and roof type. Thus, farmers can even avoid selecting bushy type trees for lac cultivation. The technology developed a concept that shade is harmful for lac production in winter/ rainy season.

For enhancing lac production, culture of lac insect is being encouraged and promoted on bushy type lac host plants of *Flemingia* spp on plantation basis (Bhattacharya and Jaiswal 2004, Singh *et al*. 2008). Weeds are a menace due to their adverse impact on lac host plantation as it (i) retards the growth of hosts by competing for natural resources during raising of new plantations, and (ii) affects tillering of bushy hosts after coppicing as well as growth and development of host plants. Weeds also create an inconvenient condition in the field for the workers. Manual removal of weeds consumes a large amount of labour force and expenditure. In such situations, use of herbicides becomes an obvious choice. One spray of glyphosate @ 1.0 kg a.i./ ha in the plantation at 7 to 10 days prior to lac insect inoculation can check weed growth effectively. Weed control efficiency in Glyphosate application is 89%, which is at par to hand weeding. Stick lac production is expected to be 11% lesser than hand weeding and 38% higher than unweeded control.

Twentieth century is the age of technology. It is not an exception to lac cultivation. In a vast country like India there are several agroclimatic zones which are unique in its resources and productivity. Therefore, various types of

technologies are required for catering need for various zones. There could be variation in economic status of lac growers. Some might be requiring for low cost technology while others believe in input intensive lac cultivation. Slowly, lac cultivation is paving its steps towards plantation oriented delivery system where relatively big farmers/ entrepreneurs are entering into the field and is developing a new trend in lac production system. The lac production technologies developed at this Institute is disseminating among farmers and is able to cater the needs of all types of people.

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