

Technologies Developed

A. Lac Production

1. *Semialata*-early *kusmi* breed combination

Flemingia semialata has shown great promise for lac production due to its fast growth, tender shoots and suitability for intensive lac cultivation and is a boon to particularly those farmers who do not have lac-host trees but are interested in lac cultivation.



Major recommendations of the technology developed are: (i) Early maturing variety of *kusmi* strain (maturing in June and January - about one month before the normal time *i.e.* July and February) should invariably be used for lac cultivation on *semialata*, (ii) Lac insects should not be allowed to settle on more than 35 % inoculable space of the available shoots, (iii) Paired row system of planting should be followed and (iv) Irrigation at fortnightly interval after cessation of the monsoon (December – January) should be provided to lac cultures on *semialata*

44% increase in yield of per meter broodlac and 30.89 % increase in sticklac was recorded and no detachment of broodlac from the stem was observed by following the recommendations. Early harvest also promises better growth and plants are ready on time for inoculation of the next crop.

2. *Ber*-late *kusmi* breed combination

Ber is the most preferred host for lac cultivation among the growers because it can be utilized for both the strains of the lac insect and comparatively, it is also one of the fastest growing lac-host among the tree species with a very good pruning response. Under this technology for *kusmi* lac cultivation, *ber* is pruned in the month of March / April and late maturing variety of *kusmi* strain of lac insect is inoculated in the month of July-August. Recommended package of practice for *kusmi* lac cultivation on *ber* is followed and the crop is harvested in the coming March / April which serves as pruning also. Two main interventions *viz.*, use of late maturing breed and four-six month old shoots for inoculation has resulted in sustainability of *kusmi* lac production on *ber*.



Inoculation with late maturing variety of *kusmi* strain (maturing in July / August - about one month after the normal time *i.e.* June / July) delays the lac crop harvesting time to March / April which not only tends to coincide with the pruning time of the tree but also more lac yield (3-26%) was obtained in comparison to early maturing varieties.

3. Yellow *kusmi* breed of *Kerria lacca*

Yellow *kusmi* lac insect has been developed through cross breeding, selection and multiplication. The insect has good productivity on *semialata* and *kusum* in that order. The breed has better productivity in comparison to existing lac insect breeds and it yields yellow lac dye.

Being early maturing breed, is most suitable for broodlac production on *semialata*. Broodlac output:input ratio is 8-10 on *semialata* and 4-6 on *kusum* which is 10-20% more than the conventional



breeds. On *ber*, its performance is comparable to existing early maturing *kusmi* breeds.

Lac dye present in the lac insect body is an important eco-friendly by-product of lac processing industries. Natural dyes score over synthetic ones and are gaining ground due to environmental and health concerns. Lac dye has got varied applications in different fields especially textile industry. Being non-toxic, food grade dye is also used as a colouring agent in food products. Wild lac insect yields crimson dye whereas, this new breed yields yellow coloured dye.

4. Lac cultivation on *arhar* (*Cajanus cajan*)

Arhar (*Cajanus cajan*) is an important pulse crop. It has also been recorded as a lac-host. Out of three varieties of *arhar* tested for intensive lac cultivation on plantation basis, late maturing variety (*Bahar*) was found to be the most suitable. Under paired row system with a spacing of 50 cm between plants and paired rows, and one meter between rows, about 26,400 plants can be accommodated in one ha. Seeds sown in June become ready for inoculation in October / November for *rangeeni* summer crop.

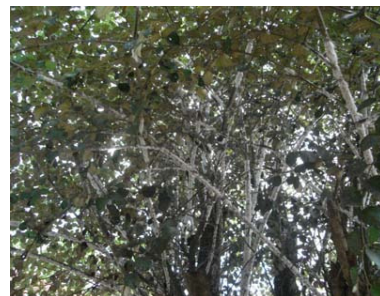


By inoculating 50g broodlac per plant, approx. five times broodlac can be obtained along with the pulse grains. Although 32% reduction in grain yield occurs due to lac cultivation on *arhar* but profit obtained from lac is much higher than the crop loss. In terms of raw lac, about 1750 kg scraped lac and 900 kg pulse can be obtained from one ha land. Fortnightly irrigation during Feb.-March and at 10 days interval during April-June is required under Ranchi conditions.

Additional expenditure on about 1500 kg broodlac is required. About 25% more income in comparison to recommended sole crop system of *arhar* can be generated, even if lac produced is sold as raw lac.

5. Management of soil fertility for winter season *kusmi* lac production on *ber*

Application of 200 g nitrogen, 150 g each of phosphorus & potassium and liming @ 2.25 kg/tree is recommended for *kusmi* lac production on established plantation of *ber* (4.5x4.0 m² spacing) in acid lateritic soils of Jharkhand. Half dose of nitrogen and full dose of phosphorus and potassium are used at the onset of monsoon at 4-6" deep rings dug at 60% of canopy diameter. Rest half of nitrogen is applied on first week of September matching with time of male emergence. Liming is done on the whole canopy area 2-3 months before application of fertilizer.



Lac yield was found to increase 34% only due to potassium application in normal soils of the region.

6. Development of high density plantation of *ber* for lac cultivation

Ber plants are raised under triple hedge system in the plot (which accommodates 536 plants in 45mx16m area). The plant to plant distance is maintained 1.0m (within) and row to row 0.75m (between); the inter-strip spaces between two triple hedges are 2.5m. Thus, 7,445 plants can be accommodated in one hectare.

Whereas, in the recommended planting system (4X4m) of *ber* accommodates about 625 plants per hectare



By the time of two years more than 50% of the plants were ready for inoculation of brood lac where as in normal system planting it takes 5-6 years for establishment

Winter season crop of *kusmi* strain was raised on two year old *ber* plants. Using 12kg of brood lac, 35kg lac (19 kg brood lac and 16 kg rejected lac) was harvested. After three years *aghani* crop was raised using a total 29.4kg broodlac, in two strips containing 268 plants and 110 kg lac (including 30kg broodlac) was harvested.

7. Kusmi lac cultivation on Siris tree

Siris (Albizia procera) a fast growing leguminous tree, has been identified as a potential lac host for *kusmi* lac production. In order to fill up the gap between demand and supply of *kusmi* broodlac, the technology of *kusmi* broodlac production has been standardized. The average productivity of broodlac is 9.00 kg (per kg of brood inoculated) for 18 months gestation period. There is no yield loss due to shedding of petioles during winter crop and it contributes around 20% in total yield. The petiole encrustation is thicker than primary and secondary shoots.



The quality of broodlac and lac is at par with *kusmi* lac. The plantation of this tree species is ready for lac crop production during 5th year onwards and a four year old tree is capable of producing five kg of broodlac. Thus, this species has potential to supplement broodlac requirement for inoculating higher number of *kusmi* trees which are already available in forest areas.

8. Kusmi lac production technology on Prosopis juliflora during winter crop season

Prosopis juliflora, a noxious weed in the country has been found suitable for successful cultivation of *kusmi* lac insect. The potentiality trials in Gujarat under natural plantations produced a yield ratio of 1:7 output / input) showing promise of this new host.



9. Summer season (jethwi) sticklac production on ber trees with the help of pitcher irrigation

Effect of pitcher irrigation with 4 pitchers per tree (10 litre capacity / pitcher) with seepage rate of 0.05 lph was studied on summer *kusmi* lac crop (*jethwi*) and pruning response on *ber*. Pitcher irrigation resulted in 3.1 and 5.2 times higher sticklac yield over control (no pitchers) in first and second year of study, respectively.

10. Moisture conservation through organic mulching for establishment of ber (Ziziphus mauritiana) plantation under rainfed condition

Application of mulch @ 10 kg/plant around the *ber* plant periphery in 0.8 m² to 1.76 m² area (depending upon the canopy area of the plant) during its establishment stage was found effective under rainfed condition in Jharkhand. Mulching conserved 26.2 % higher moisture over control during the post monsoon period. It also led to improved *ber* plant height, basal girth and crown spread by 22.8, 24.2 and 28.9 per cent, respectively as well as higher biomass production (86%) over control (without mulch). Occasional spraying of *Dursban* 20 EC (2 ml/l of water) on mulch material is recommended for termite control.



11. Lac crop protection by newer insecticides:

Lac crop is subject to incidence of insect pest causing substantial loss in quantity and quality due to three main insect predators. One belongs to the Neuroptera and the other

two to Lepidoptera. The lepidopteran species causes 30-35% crop loss but neuropteran may inflict total loss of *kusmi* lac crop. In view of limitation with endosulfan and also ineffectiveness against neuropteran species, three new low volume, IPM based insecticides have been identified. These are safe to lac insect and effectively manage to control all these insect predators for ensured production. The average cost of lac crop protection of these insecticides namely indoxacarb, fipronil and spinosad from *palas*, *ber* and *kusum* tree comes around Rs. 30, 75 and 375 per tree for an estimated crop worth Rs. 800, 1,500 and 8,000 respectively

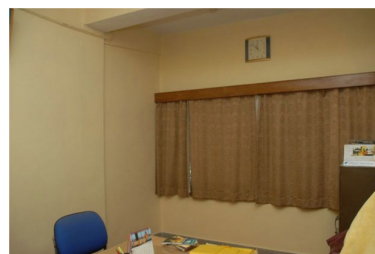
12. Eco friendly pest control for lac crop through bio pesticide and egg parasitoid

Novel strategies for pest management in lac culture have been developed by augmenting bio-control and bio-rational approaches to reduce the load of chemical pesticides in lac ecosystem. The approaches utilized consist of egg parasitoids, *Bacillus* based bio-pesticides, habitat manipulation as well as utilization of essential oils for management of lepidopteran lac insect predators. For the management of neuropteran lac insect predator, *Chrysopa* sp., a light trap has been developed to trap the adult insects during night hours.

B. Process and Product Development

1. Lac-based water-thinnable interior paint

Lac-based water-thinnable coating material is based on lac modified with suitable synthetic resin for cementitious surfaces. It can be applied by brush to produce hard, smooth and matt finish on POP treated surface, limed surface, asbestos and masonry surfaces. The films dry in 10-12 min. The air-dried films show excellent resistance towards water, acid and desired alkali resistance. The paint film on interior wall remained unaffected for more than four years of its application on POP treated surfaces (no flaking, peeling off and discoloration). The properties of the developed composition were found to be comparable with good quality commercial samples. Covering power is 120 ft² per liter for double coat.



2. Lac based fruit coating formulation for kinnow

Waxing is normally recommended in fruits like citrus and apples to improve their appearance features (shine, colour) and self life. Benefits obtained by waxing of fruit are improved appearance, less moisture loss and shriveling, reduced postharvest decay and longer shelf-life.

Around 40 litres Lac-based fruit formulation for kinnow has been evaluated in more than ten kinnow waxing and grading plants at Abohar and approximately 83 tons of kinnow fruits were coated with above formulation. The kinnow traders in Punjab felt that its application produced better results in respect of gloss, spread area and firmness to the fruits as compared to commercial waxes.



Coated kinnow fruits

3. Shellac based dental plates

Dental base plates are used to replace missing teeth just like a false teeth. The plates are used as an intermediate in prosthesis. After checking in the patient's mouth and possible corrections, the base plates are replaced with synthetic resins. The base plates are plastic compositions comprising of shellac, fillers and colouring



Shellac based dental plates

matter. The base plates can be easily softened over a flame and modeled to the desired shape. Upon cooling, the base plate retains its shape to form a strong and dimensionally stable intermediate base for the prosthesis. Shellac based dental plates have good heat stability, colour stability, solubility, resistance to climate changes, strength, plate softening, mouldability

4. Lac based nail polish

Eco friendly nail polish developed from lac gives better performance than commercial samples available in the market in quality aspects. Lac based nail polish of different shades were evaluated by local dealers of cosmetics. It was further evaluated by local nail polish manufacturers and also by distributing them through beauty parlour to interested consumers of nail polish and according to them it offers better quality than commercial samples.



Nail polish available in the market are all synthetic based with petroleum products and synthetic dyes. Lac based nail polish are eco-friendly and cheaper. It gives better performance than commercial products available in the market with respect to touch dry time, gloss, smoothness and hardness, durability and resistance to water.

5. Aqueous lac varnishes for earthenware and bamboo based articles

Lac is insoluble in water and due to its acidic nature, it dissolves in water in the presence of alkalis, forming a salt. The aqueous lac varnishes have been treated with cross-linking agent to improve their properties. The varnish is water based and eco-friendly. The varnish can be used for decoration and protection of earthenware and bamboo based articles, which in turn, can fetch higher price in the market. The polished surface does not lose shining and does not whiten when it comes in contact with water. Varnishes prepared from ammonia or morpholine may be used for coating of earthenware and bamboo articles to make them more attractive and decorative. Morpholine based varnish gives the highest gloss (shinning) and may be used where higher gloss is required with marginal increase in production cost. The varnishes can be applied by brush or cotton pad.



6. Small Scale lac processing Unit

Lac growers sell sticklac immediately after scraping at throwaway prices due to associated storage problems. Proper storage of sticklac requires large space with adequate ventilation. Such facility is not available in lac grower's houses. If sticklac is stored in bags, it forms lump which is difficult to crush while processing. Further lump formation leads to deterioration in quality of lac. The process of making seedlac from sticklac



involves five major unit operations *i.e.* crushing, washing, drying, winnowing and grading.

This can be addressed by establishing Small Scale Lac Processing Unit (Capacity-100 kg/day) which is a set of four machines viz. *Lac crusher*, *Lac washer*, *Lac Grader* and *Lac winnower*. These machines can be driven manually or with electric motor. If processing unit remains functional for six months in a year, about 750 man-days of employment can be generated from the unit. From such unit net profit of about Rs.25,000 per month can be earned. For establishing the unit about 0.2 hectare of land is required.

7. Recovery of by-product Lac dye from effluent of Lac washing

Lac dye, a by-product of lac industry, is generally lost in the effluent during washing of sticklac in primary processing of lac in which the basic raw material sticklac is converted into a semi-refined product : seedlac. The sticklac, apart from lac resin, also contains water-soluble lac dye (laccaic acid upto 1%). It is a mixture of at least five closely related compounds all being anthraquinon derivatives which has been assigned the names as laccaic acid A,B,C,D & E. This dye can be recovered upto extent of 50% (technical grade) from effluent of sticklac washing. Lac dye can be recovered first in form of Technical grade (crude, dye content: 60-70%) suitable for dyeing purpose . The Technical grade lac dye can be purified for increasing its dye content above 90% with yield of 0.125% by weight of seedlac..



8. Guggul tapping tool

Suitable tapping technique is the key to sustainable harvesting of guggul from its tree *Commiphora wightii*. Use of improper tapping device and method adversely affects the *C. wightii* plant. The tool developed by JNKVV, Jabalpur Center of Network Project on Harvesting, Processing and Value Addition of Natural Resins and Gums can be used for efficient tapping of this gum. It is a simple rolling type tapping device for tapping guggul plants. The tool is made up of Stainless Steel and has a circular blade of 4cm diameter and 2mm thick with sharp edge on its outer periphery. The tool has been tested on about 50 guggul plants during 2010 in the states of Gujarat and Madhya Pradesh.



9. Lac dye based natural Alta

Alta is an important cosmetic item during worship and of ladies. It is used by Indian women for decorating their feet and festivals. It is believed in our country that beauty of without decorating her feet with *alta*. Traditionally Alta was period lac dye was used for dyeing silken Sarees and for the traditional preparation has long been forgotten after the e industry which offers a variety of brilliant fast red dye at ch produced from synthetic dye. The quality of the *alta* available for the skin. Red *alta* developed from lac dye (natural dye) and for skin.



10. Aleuritic acid (technical grade) manufacturing with improved yield

Aleuritic acid, chemically 9,10,16-trihydroxypalmitic acid, is a major constituent acid (~35%) of lac resin. The demand of aleuritic acid is continuously growing in foreign countries as well as in domestic market especially in the field of perfumery and pharmaceuticals. It is an excellent starting material for the synthesis of different bioactive & perfumery compounds like civetone, ambrettolide, isoambrettolide etc, which have the musk like odour. Besides the perfumery industries, aleuritic acid has its application in various fields such as glucose



monoaleuritate in medicines, preparation of plastics with good adhesive properties, lacquers, as an antioxidant agent for protecting skin etc

Aleuritic acid (tech. grade) has been prepared using the process developed at the Institute from fresh as well as 3 to 8 years old seedlac in the pilot plant (capacity: 2kg/ batch) with different filtration methods and conditions. The process of manufacturing of technical grade aleuritic acid was standardized in pilot scale for higher yield. The products obtained were evaluated for quality parameters like melting point and acid value.

The yield of aleuritic acid obtained in different trials varied from 19 to 19.8% of the weight of fresh seedlac and 16 to 16.7% from old seedlac with melting point in the range of 94-96°C. The yield of aleuritic acid obtained at industrial scale by different manufacturers at present is around 14-15% of the weight of seedlac. However, the process developed may be tried in a commercial plant of aleuritic acid for large scale trials.