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Conserving broodlac on *Flemingia semialata* in *Albizia procera* (*siris*) plantation during summer season under rainfed condition

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Abstract

Lac, due to its use in high valued diversified field and being bio-degradable in nature, has gain momentum in cultivation in recent times, accounting for about 50–60% of the total world lac production in India. Out of cultivation of two dominating lac strain (*kusmi* and *rangeeni*), focus of *kusmi* lac cultivation has remained on *Schleichera oleosa* (*kusum*) as summer crop and on *Ziziphus mauritiana* (*ber*) and *Flemingia semialata* as winter crop. However expanding plantation of *F. semialata* in newer non-conventional areas (area without alternate host) requires attention on sustainable broodlac production during summer on other conventional lac host. Present investigation was carried out to find out the performance of *F. semialata* planted in *Albizia procera* (*siris*) plantation for conserving broodlac during summer season at research farm of ICAR- Indian Institute of Natural Resins and Gums, Ranchi for two consecutive seasons. *Semialata* plants near (plants in the periphery of 3.0 m radius of *siris* tree) and far from *siris* tree (plants located in between *siris* trees but beyond 3.0 m radius of *siris* tree) recorded 84.8 and 60.9 per cent higher broodlac, 32.3 and 25.6 percent higher total lac yield with 20.9 and 18.4 per cent lower rejected lac yield over control (plants located in open environment), respectively. The mean broodlac yield per plant on *F. semialata* planted near and far from tree in *siris* plantation were 134.1 and 116.8 g/plant, respectively, with average yield of 125.4 g/plant. Broodlac yield recorded during summer season under *siris* plantation in the study was 58.2 per cent lower than broodlac yield potential (300 g/plant) of normal winter season crop on *F. semialata*, but it may be inoculated on 3-4 bush of *semialata* to raise winter crop. This will help to maintain crop cycle and thus sustainable lac cultivation. Higher broodlac and lesser rejected lac yield on *semialata* in *siris* plantation could probably be due to higher shoot length, weight of single cell, weight of broodlac per meter of shoot length and lesser weight of rejected lac per meter of shoot length. Hence, sustainable broodlac production on *F. semialata* may be taken under *siris* plantation during summer in newer areas, where suitable lac host species for summer lac cultivation (*kusum)* is not available.

Keywords: Rejected lac, *Flemingia semialata,* Lac host, *Siris*, *Kusmi lac*

Introduction

Lac, a resinous compound secreted by lac insect (*Kerria lacca* Kerr) while feeding on phloem sap of certain plants called lac hosts, has got potential to play an important role in improving the economy of rural people in the lac growing areas. India is the largest producer of lac in the world, accounting for about 50–60% of the total world lac production. Total production and export figures of lac during 2013-14 were 21,008 and 8,158 tons, respectively [11]. *Flemingia semialata* has been emerged recently as one of the most suitable lac host plant which is bushy in nature and quick growing, and more importantly lac cultivation can be started from second year on plantation basis as against 5-12 years gestation period for lac cultivation on conventional host trees *viz.*, *Butea monosperma* (*palas*), *Ziziphus mauritiana* (*ber*) and *Schleichera oleosa* (*kusum*) found in forest and sub-forest areas. Use of these conventional host trees have many deterrents for new lac grower, such as difficulty in lac cultivation operations on account of its scattered nature and climbing need on trees, vulnerability to theft due to its presence in remote forest areas, besides higher gestation period.

The practice of lac cultivation on *F. semialata* has been standardized [3, 6] and it provides very attractive returns [9]. This has attracted lac growers for lac cultivation on F. semialata on plantation basis and as a result lac cultivation on this bushy species is spreading in new areas like Maharashtra, Karnataka, Uttar Pradesh, Bihar, Odisha, etc. This may add a new opportunity for ensured lac production on plantation basis in the home stead [4]. But, continuous availability of broodlac for maintaining crop cycle on this species is a problem due to high temperature and low moisture availability during summer season. Under such situations the growers have to transport broodlac from conventional lac growing areas, especially broodlac produced on *kusum* trees. The crop cycle of *kusmi* lac insect (strain of lac insect cultivated on *F. semialata*) is January-February to June-July (summer) and June-July to January-February (winter), known as *jethwi* and *aghani* crop, respectively. For sustainable lac cultivation, availability of broodlac should be ensured in nearby areas and for this purpose, both the crop should be taken in nearby areas. Normally *aghani* crop is cultivated successfully on *F. semialata* and *jethwi* crop is taken on *kusum*, and broddlac produced is inoculated on *F. semialata*, *ber* and even on *kusum*. *Jethwi* crop on *F. semialata* for broodlac purpose may be taken only under irrigated condition where maximum temperature does not exceed 42 ºC with 35-40 ºC as optimum. In newer areas of lac cultivation, *kusum* tree is not available. Hence, present investigation was carried out to find out the performance of *F. semialata* under *Albizia procera* (*siris*) plantation for conserving broodlac under rainfed condition during summer season.

Materials and Methods

A field experiment was conducted at the research farm of ICAR- Indian Institute of Natural Resins and Gums, Ranchi, India ($23^0$23" N latitude, $85^0$23" E longitude and 650 m above mean sea level) for two consecutive years during 2014 and 2015. The climate of the region is characterized mild, salubrious climate, with a rather heavy rainfall pattern of about 1400 mm average, of which about 1250 mm is during the monsoon. Soil of the experimental field was lateritic type, pH 4.99 and was having the contents of available organic carbon - 0.40%, nitrogen - 178 kg/ha, phosphorus -51.01kg/ha and potassium -492.8 kg/ha with EC -0.190 dSm^{-1}.

A new plantation of *F. semialata* was established under old *siris* plantation. Siris trees were at distance of 7.0 m (row spacing) x 8.0 m (plant spacing). An area of 36 m x 21 m, accommodating 3 rows and 15 trees of *siris*, was taken for establishment of new *semialata* plantation. *Semialata* was planted having spacing of one meter between plant to plant and 0.5 meter between two paired rows. After a paired row (having two single rows), two meter space was given for sufficient aeration and to facilitate mechanical operations like ploughing by power tiller. In between *siris* trees, 1.0 m space was left to both side from *siris* tree and three paired rows (six single rows) of *semialata* was planted during July 2013, accommodating 540 *semialata* plants. *Kusmi* broodlac was inoculated @ 30 g per bush during February 2014 and 2015, and harvesting-cum-pruning was done in July 2014 and 2015, respectively. Light settlement (<25-30 cm) on each shoot was allowed. Higher length of settlement was removed by rubbing with the cotton after removal of used-up broodlac. No irrigation was given during the period. Other standard package of practices was adopted to raise the lac crop.

Three treatments were imposed in the field. Treatments were *semialata* plants lying in the periphery of 3.0 m radius of *siris* tree (T_1), in between *siris* trees but beyond 3.0 m radius from siris tree (T_2) and control (T_3) which was far from *siris* tree under open environment. For recording observations, nine spots (replications) of each treatment having five *semialata* plants were selected randomly in accordance of purview of treatments. Thus, there were 45 plants of *semialata* of each treatment. At the time of maturity of lac crop, height of shoots and number of tillers per bush were recorded. After harvesting of lac crop, encrustation length was measured. Rejected lac was separated and weight of brood and rejected lac was taken on unit length as well as bush basis. Weight of fifty single cells of each replication of all the treatments were taken after separating from broodlac. Lac encrustation was scraped and weight was taken on unit length basis.

The data of both the crop season were statistically analyzed separately according to Cochran and Cox [1]. Data are presented year wise for better interpretation of experimental results. Various treatments were compared under randomized block design. The critical difference (CD) was computed to determine statistically significant treatment differences.

$$CD = (\sqrt{VEr\&1})\ t_{5\%}$$

where, VE is the error variance, r is the number of replications, $t_{5\ \%}$ is the table value of t at 5 % level of significance at error degree of freedom.

Results and Discussions

The data regarding the plant height of *F. semialata* at harvesting of lac crop are presented in Table 1. The analysis of variance (ANOVA) showed that plant height was significantly affected by location of plant either in the *siris* plantation (distance from *siris* tree) or control (open environment). Plant near the *siris* tree resulted in significantly higher height as compared to control (plants situated in open environment). Plants in between *siris* trees but beyond 3.0 m radius from *siris* tree showed similar plant height to control. Higher plant height near *siris* tree may be attributed to more shading effect near the plants. Thangam and Thamburaj [10] have also reported that plants grown under shade exhibited better growth in term of plant height as compared to those in open field. Similarly Paez and Lopez [8] observed that plant height and leaf area increased in the shade. Murakami *et al*. [7] stated that red light interception caused low ratio of red and far red light which results in increase in plant height. Number of tillers per bush was significantly higher under control compared to *semialata* planted in *siris* plantation under shade during first year; however there was no significant difference during second year of experimentation. This could probably be attributed to improved light, temperature and relative humidity conditions, which increased photosynthesis and consequently sugars, which stimulated more lateral bud sprouting.

Total length of lac incrustation on a *semialata* bush, weight of brood and rejected lac in unit length of shoot also differed significantly under various locations of *semialata* plants in *siris* plantations and control (Table 1). *Semialata* planted near the *siris* tree recorded significantly higher total length of lac incrustation and weight of broodlac, and lesser rejected lac compared to other treatments. Plants, located in between *siris* trees but beyond 3.0 m radius, showed higher lac encrustation and broodlac weight, and lesser rejected lac than control. Almost similar trend was recorded in case of weight of lac cell and scrap weight, and yield of brood, rejected and total lac (Table 2). *Semialata* plants near and far from *siris* tree recorded 84.8 and 60.9 per cent higher broodlac, 32.3 and 25.6 percent higher total lac yield with 20.9 and 18.4 per cent lower rejected lac yield over control, respectively. The mean broodlac yield per plant on *F. semialata* planted near and far from tree in *siris* plantation were 134.1 and 116.8 g/plant, respectively, with average yield of 125.4 g/plant. Broodlac yield recorded during summer season under *siris* plantation in the study was 58.2 per cent lower than broodlac yield potential (300 g/plant) of normal winter season crop on *F. semialata* [5]; however it may be stated good yield for broodlac conservation point of view. Broodlac conserved (125.4 g/plant) during summer may be inoculated on 3-4 bush of *semialata* to raise winter crop for which broodlac requirement is 40-50 g/bush. This will help to maintain crop cycle and thus sustainable lac cultivation.

Higher broodlac and lesser rejected lac yield on *semialata* in *siris* plantation could probably be attributed to higher shoot length, weight of single cell, weight of broodlac per meter of shoot length and lesser weight of rejected lac per meter of shoot length. In *jethwi* crop, when temperature starts rising April onwards, soil becomes scanty in moisture and as a result phloem sap content (food of lac insect) of plant starts decreasing in rainfed condition. Direct sun has also detrimental effect on lac insect, resulting in mortality of lac insect in both the conditions [2]. Due to partial shading under *siris* canopy, direct sun heat and temperature may reduced to such extent which favour the growth of lac insect and maintained the soil moisture level, resulting in lesser mortality of lac insect and host plant as well. Besides, light penetration and temperature may remain at optimal level for photosynthesis of the plant. On the other hand under open condition (control), direct sun heat and higher temperature caused higher lac insect mortality and host plant which is reflected as higher weight of rejected lac of unit length of shoot as well as higher yield of rejected lac on per plant basis.
From present investigations, it is concluded that broodlac may be conserved on *F. semialata* during summer (*jethwi* crop) under *siris* plantation, where suitable lac host for summer (*kusum)* is not available. This may help for sustainable lac production on *F. semialata* in newer areas of lac cultivation.

Table 1: Growth of plant, lac encrustation and weight of brood and rejected lac under siris plantation

Treatment		Av. height of shoots at harvest (m)		No. of tillers/bush		Encrustation length/bush (cm)		Broodlac/ m shoot length (g)		Rejected lac/ m shoot length (g)	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T_1	Near siris tree	0.95^a	1.15^a	4.44^b	6.87	92.23^a	175.22^a	140.89^a	165.88^a	53.81^c	63.54^c
T_2	In-between siris trees	0.90^{ab}	1.10^{ab}	4.56^b	6.96	80.75^b	110.39^b	121.91^b	142.07^b	66.60^b	78.16^b
T_3	Control (open condition)	0.87^b	1.06^b	4.87^a	7.09	51.62^c	80.10^c	93.78^c	110.93^c	79.04^a	92.75^a
S. Ed.		0.024	0.025	0.096	0.146	1.766	2.726	2.734	3.66	1.150	1.587
CD (P= 0.05)		0.050	0.053	0.203	0.309 (NS)	3.743	5.780	5.796	7.759	2.437	3.364

Table 2: Weight of lac cell, scrap weight and lac yield under siris plantation

Treatment		Weight of cell (mg)		Scrap weight/m shoot length (g)		Lac yield (g/plant)					
						Broodlac		Rejected		Total	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T_1	Near siris tree	28.67^a	32.13^a	50.85^a	57.40^a	112.60^a	155.61^a	43.41^b	70.95^c	156.36^a	226.56^a
T_2	In-between siris trees	25.46^b	30.52^b	40.23^b	45.69^b	101.52^b	132.04^b	41.39^b	76.72^b	143.23^b	208.76^b
T_3	Control (open condition)	20.99^c	24.47^c	34.72^c	38.48^c	60.75^c	84.39^c	57.84^a	86.83^a	118.83^c	171.20^c
S. Ed.		0.509	0.641	0.969	1.220	1.958	2.383	1.105	1.734	3.228	4.162
CD (P= 0.05)		1.079	1.359	2.055	2.587	4.151	5.053	2.342	3.676	6.844	8.823

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