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Study on Kusmi lac production in Central Narmada valley, Madhya Pradesh

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ABSTRACT

The present study evaluates the seasonal performance of Kusmi lac (*Kerria lacca*) cultivated on *Schleichera oleosa* in the Central Narmada Valley agro-climatic zone of Madhya Pradesh, India. Data were collected during the 2019–2020 cropping seasons from seven villages in the Narmadapuram district, involving 70 lac-growing farmers. Two seasonal crops, Aghani (winter) and Jethwi (summer) were compared based on lac yield per tree, yield per foot lac stick, fresh and dry weight of 100 lac cells. Results showed no statistically significant difference in lac yield per tree or per foot stick between the two seasons, with the Jethwi crop marginally outperforming Aghani in both parameters. However, the Jethwi crop exhibited significantly higher fresh and dry biomass per 100 lac cells, indicating enhanced resin deposition during the summer season. This suggests that while total yield may not vary significantly, qualitative aspects such as resin density and cell biomass are superior in the Jethwi crop. These findings highlight the adaptability and year-round potential of Kusmi lac cultivation on *S. oleosa*, offering insights for optimizing lac production under central Indian conditions.

KEYWORDS

Kusmi Lac, *Schleichera oleosa*, Aghani, Jethwi, Lac Yield

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Lac is a natural resin that is produced by a tiny insect called *Kerria lacca* (Kerr), belonging to the family Tachardiidae (Homoptera) (Sharma, 2016). This insect feeds on plant sap and secretes a resinous substance (lac) on the branches of its host tree (Bashir *et al*., 2022), which hardens when it comes in contact with air. The adult lac insects are protected by a hard lac crust, and the resin they produce is completely natural, biodegradable, and non-toxic. As a result, it is widely used in various industries including food, textiles, and pharmaceuticals (Sharma *et al*., 2020). The lac insect has been found to have around 113 host tree species and can complete its life cycle on them (Kumar and Kumar, 2013). However, only three traditional host plants such as Kusum (*Schleichera oleosa*), Palas (*Butea monosperma*) and Ber (*Ziziphus mauritiana*) are used for commercial lac cultivation (Bhatnagar *et al*., 2020). These host plants are specifically chosen for their ability to provide the necessary nutrients for the lac insect to thrive and produce high-quality resin. In India, there are two major strains of the lac insect known as Kusmi and Rangeeni, each with specific host plants. *S. oleosa* is the suitable host for the Kusmi strain while *B. monosperma* is suitable for the Rangeeni strain (Kumar and Dwivedi, 2023).

However, *Z. mauritiana* is a common host for both strains of the lac insect (Ghosh *et al*., 2013). The Kusmi lac insect has played a crucial role in the production of lac crops in India, accounting for 25% of the total production (Sarvade *et al*., 2016). This particular strain of lac insect is highly prized for its unique ability to produce two crops in a year, the summer crop or Jethwi crop and the winter season crop or Aghani crop (Yogi *et al*., 2016). These crops require six months each to mature, making it important to carefully consider the suitable host plant and climatic conditions when starting lac cultivation (Shanker *et al*., 2023).

As the state Madhya Pradesh is situated in the central part of India, it holds a significant position in the production of Kusmi lac (Kumar *et al*., 2023). During the year 2013-14, Madhya Pradesh contributed to 2,497 tons of the total 21,008 tons of lac produced in India (Sahu, 2016). The production of Kusmi lac in Madhya Pradesh is mainly dependent on *S. oleosa* tree, which are abundantly available in the state (Sarkar *et al*., 2022). With the availability of these host trees and favorable climatic conditions, the state has been able to achieve high production levels of Kusmi lac (Sharma, 2022).

In addition to its industrial importance, lac cultivation plays a vital role in supporting the livelihoods of tribal and forest-dependent communities in India (Jaiswal *et al*., 2021). It is a low-cost, sustainable, and eco-friendly enterprise that requires minimal external inputs, making it highly suitable for inclusion in agroforestry and farm forestry systems (Sarangthem *et al*., 2023). Lac farming contributes to income diversification, especially in remote and underdeveloped regions such as parts of Madhya Pradesh, Jharkhand, Chhattisgarh, and Odisha, where access to conventional farming infrastructure is limited (Chengappa, 2018). Despite its socio-economic relevance, the sector remains largely informal and lacks standardized agronomic practices tailored to regional conditions. Moreover, while studies have addressed host plant preferences and pest management, very few have quantitatively evaluated the seasonal dynamics of lac production under real-field conditions using robust statistical methods. A scientific comparison of lac productivity and resin characteristics between the Jethwi and Aghani seasons is therefore essential to guide farmers in making informed decisions about crop scheduling, resource allocation, and marketing strategies (Prasad, 2014). Most research has focused on laboratory studies or varietal screening. Therefore, the current study was undertaken to assess and compare the yield potential and cell biomass characteristics of Kusmi lac during Aghani and Jethwi seasons across selected villages in the Narmadapuram district. Understanding these seasonal variations will help in optimizing crop scheduling, improving productivity, and enhancing economic returns to farmers and stakeholders involved in lac production. In order to further understand the production capabilities of Kusmi lac, a present study was conducted in district Narmadapuram, Madhya Pradesh on *S. oleosa* host tree.

Materials and Methods

The study was conducted in district Narmadapuram of the state of Madhya Pradesh, India during the year 2019-20. The district Narmdapuram comes under 'Central Narmada valley' agro-climatic zone. Seven villages were selected from the district and ten farmers were chosen from each village for data collection (n=70). The study recorded data such as lac yield per tree, lac yield per foot lac stick, and dry weight per 100 cells from each farmer. Statistical analysis of the data was conducted t-test.

Table 1. Agro-climatic zone, district and villages

Agro-Climatic Zone	Name of District	Name and No. of Village Covered	No. of Lac Growers Covered
Central Narmada valley	Narmadapuram	1. Kamti 2. Khapa Kalan 3. Vijanmhigh 4. Dangahigh 5. Dhadav 6. Padav 7. Murgidhana	100

Results and Discussion

Data collected from seven villages of district Narmadapuram was analyzed and described under following head:

Lac Production per Plant

The average lac yield per plant was 36.03 kg during the Aghani season and 40.07 kg during the Jethwi season, indicating 11.2% higher yield in the summer crop. Among the seven villages, Khapa Kalan recorded the highest yield in both seasons, 40.6 kg (Aghani) and 42.7 kg (Jethwi). Padav and Murgidhana consistently showed lower yields compared to other sites, with Padav recording only 26.5 kg (Aghani) and 40.0 kg (Jethwi), and Murgidhana recording 25.8 kg and 28.6 kg, respectively. The t-test analysis for yield per plant showed a calculated t-value of -1.296, which was not statistically significant ($p = 0.220$, two-tail), suggesting that seasonal differences in yield per plant were not significant across the dataset.

This indicates that the cultivation practices used during both seasons were similar and had a similar impact on lac production. Therefore, it can be inferred that if the cultivation practices remain consistent, the lac production would be at par in both seasons. The similarity in yield suggests that *S. oleosa* serves as an equally effective host during both cropping seasons. The marginally higher yield during the Jethwi season may be attributed to favorable environmental conditions such as temperature and humidity, but the results confirm that with uniform cultivation practices, seasonal variations do not significantly affect yield per plant. These results are consistent with observations by (Kumar, 2013 and Meena *et al.*, 2019), who reported stable yield performance of Kusmi lac under controlled practices.

Table 2. Avg. Lac production/plant (kg)

S. N.	Village	Aghani	Jethwi
1.	Kamti	36.6	38.7
2.	Khapa Kalan	40.6	42.7
3.	Vijanmhigh	38.8	40.7
4.	Dangahigh	41.2	39.3
5.	Dhadav	32.5	39.0
6.	Padav	26.5	40.0
7.	Murgidhana	25.8	28.6
Mean		36.033	40.067

Lac Yield per Foot Stick Lac

Lac yield per foot lac sticks also showed higher values in the Jethwi season across all villages.

The mean yield was 44.2 g in Aghani and 50.2 g in Jethwi, representing a 13.6% increase in the summer crop. The highest stick-level yield was observed in Dhadav during the Jethwi season (55.58 g), followed closely by Dangahigh (55.53 g). In contrast, the lowest stick yield was recorded in Aghani from Vijanmhigh (34.96 g). Although the increase in mean yield from Aghani to Jethwi was clear, the difference was not statistically significant ($t = -1.991$, $p = 0.070$), indicating a trend toward higher output in the summer crop that approached significance. This suggests that factors other than the crop season may also play a role in determining the yield of lac. Further research is needed to identify these factors and understand their impact on lac yield. Nonetheless, the data highlights the potential of Jethwi crop for producing high yields and could be further explored for commercial cultivation. While the observed yield per foot stick was not statistically significant, the trend toward higher production in the Jethwi season suggests increased lac deposition efficiency.

Anees and Monobrullah (2016) highlighted that lac secretion rates are sensitive to biochemical properties of the host plant and prevailing climatic conditions. Warmer temperatures during the Jethwi season may stimulate insect feeding and resin secretion, resulting in marginally higher lac per stick (Monobrullah *et al*., 2016). However, external factors such as plant health, pest pressure, and microclimate variations across villages could have influenced the results and warrant further controlled experimentation (Madasamy *et al*., 2020).

Table 3. t-Test: Two-Sample Assuming Equal Variances

Session	Aghani	Jethwi
Mean	34.571	38.429
Variance	41.442	20.606
Observations	7.000	7.000
Pooled Variance	31.024	
Hypothesized Mean Difference	0.000	
df	12.000	
t Stat	-1.296	NS
P(T<=t) one-tail	0.110	
t Critical one-tail	1.782	
P(T<=t) two-tail	0.220	
t Critical two-tail	2. 179	

Fresh and Dry Weight of 100 Lac Cells

The fresh and dry weight per 100 lac cells showed consistent and statistically significant improvement in the Jethwi season compared to Aghani. The mean fresh weight was 6.82 g in Aghani and 7.09 g in Jethwi, while the dry weight was 5.69 g in Aghani and 6.00 g in Jethwi. These values indicate a 3.96% increase in fresh weight and a 5.45% increase in dry weight in the summer crop. Among all villages, the highest fresh weight in Jethwi was observed in Vijanm high (7.51 g), and the highest dry weight was recorded in Dhadav (6.67 g). The lowest values in both fresh and dry weights were found in Padav.

The statistical analysis confirmed these differences as highly significant. The t-value for fresh weight was 5.63 ($p < 0.01$), and for dry weight, it was 3.99 ($p < 0.01$), indicating that seasonal variation had a strong effect on biomass accumulation per lac cell. These findings indicate that Jethwi crop has a higher overall biomass production compared to Aghani crop, which could be attributed to various factors such as genetics, soil quality, and environmental conditions. Mohanta *et al*. (2014) also found the higher cell weight in Jethwai crop; it was 17.0 to 21.40 mg/cell in winter season and 19.00- 25.60 mg/cell in summer season. This significant increase in cell biomass during the Jethwi season reflects enhanced physiological performance of lac insects in summer conditions.

Table 4. Lac yield per foot stick lac (g)

S. N.	Village	Aghani	Jethwi
1.	Kamti	40.56	53.08
2.	Khapa Kalan	38.72	42.31
3.	Vijanmhigh	34.96	45.65
4.	Dangahigh	48.82	55.53
5.	Dhadav	51.62	55.58
6.	Padav	48.64	49.10
7.	Murgidhana	46.33	50.28
Mean		44.2	50.2

Mohanta *et al*. (2014) similarly found that Jethwi (summer) crops had higher cell weights (19.0-25.6 mg/cell) compared to winter, attributing the increase to higher photosynthetic rates and insect metabolism in warmer climates.

Table 5. t-Test: Two-Sample Assuming Equal Variances

Session	Aghani	Jethwi
Mean	44.236	50.219
Variance	38.217	24.969
Observations	7.000	7.000
Pooled Variance	31.593	
Hypothesized Mean Difference	0.000	
df	12.000	
t Stat	-1.991	NS
P(T<=t) one-tail	0.035	
t Critical one-tail	1.782	
P(T<=t) two-tail	0.070	
t Critical two-tail	2.179	

Table 6. Mean fresh and dry weight of 100 lac cells (g)

S. N.	Village	Aghani		Jethwi	
		Fresh weight	Dry weight	Fresh weight	Dry weight
1.	Kamti	6.59	5.25	6.5	5.43
2.	Khapa Kalan	7.21	6.26	7.23	6.13
3.	Vijanmhigh	6.65	5.45	7.51	6.52
4.	Dangahigh	6.97	6.1	7.08	6.03
5.	Dhadav	6.47	5.35	7.45	6.67
6.	Padav	6.48	5.76	6.25	5.38
7.	Murgidhana	7.4	5.68	7.64	5.84
Mean		6.82	5.69	7.09	6.00

Table 7. t-Test: Two-Sample Assuming Equal Variances

100 Cell Weight	Fresh Weight		Dry Weight	
Session	Aghani	Jethwi	Aghani	Jethwi
Mean	6.82	5.69	7.09	6.00
Variance	0.14	0.14	0.28	0.25
Observations	7.00	7.00	7.00	7.00
Pooled Variance	0.14		0.26	
Hypothesized Mean Difference	0.00		0.00	
Df	12.00		12.00	
t Stat	5.63	**	3.99	**
P(T<=t) one-tail	0.00		0.00	
t Critical one-tail	1.78		1.78	
P(T<=t) two-tail	0.00		0.00	
t Critical two-tail	2.18		2.18	

These findings suggest that even though the total yield per tree may not vary significantly, the quality of the resin as indicated by its density and cell mass is superior in the summer season.

Chen *et al*. (2010) emphasized that resin quality parameters such as density and lac composition are often more valuable for industrial applications than quantity alone. Therefore, the higher fresh and dry cell weights during Jethwi may offer greater commercial advantage despite the lack of significant difference in bulk yield.

Conclusion

The present study revealed that Kusmi lac (*Kerria lacca*) cultivated on *Schleichera oleosa* trees in the Central Narmada Valley of Madhya Pradesh performs well in both the Aghani (winter) and Jethwi (summer) seasons. Although there was no statistically significant difference in overall yield per tree or per foot lac stick between the two cropping seasons, the Jethwi crop consistently showed numerically higher yields. More importantly, the fresh and dry weights of 100 lac cells were significantly greater in the Jethwi crop, indicating enhanced resin deposition and biomass accumulation during the summer season.

These findings demonstrate the physiological advantage of lac insects during the Jethwi season, likely due to favorable environmental conditions such as higher temperatures, longer day lengths, and possibly improved sap flow in host plants. The superior cell biomass observed during summer suggests that, while total yield may remain stable across seasons, the quality and density of the lac produced are better in the Jethwi crop. This is particularly relevant for processors and industries that prioritize resin quality, as denser lac can result in higher shellac recovery rates and improved processing efficiency.

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