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RESEARCH ARTICLE

PROPAGATION TECHNIQUE AND REARING PERFORMANCE ON *LAGERSTROEMIA SPECIOSA*: A NEW FOOD PLANT OF TASAR SILKWORM *ANTHERAEA MYLITTA* D.

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ABSTRACT

Terminalia arjuna Bedd. is a slow growing plant and it takes minimum four/five years after plantation to take up silkworm rearing on these plants. Present study reports for the first time propagation technique of *Lagerstroemia speciosa* for rearing of tropical tasar silkworm *Antheraea mylitta* D. on the foliage of *L. speciosa vis a vis Terminalia arjuna.* Rooting percentage did not differ much during various seasons in *L. speciosa*. Most suitable months for vegetative propagation are from March to September. Days taken for rooting extended significantly during December in both the species. Results reveal that silkworm rearing on *L. speciosa* can be taken up after 2/3 years of plantation and two consecutive rearing can be conducted on same plants whereas *T. arjuna* takes 4-5 years and can sustain only one rearing in a year. First crop rearing results show that larval duration was slightly higher in *L. speciosa* (32 days) as compared to *T. arjuna* (28 days). Similar trend was observed during second crop also where larval duration was more in *L. speciosa* (52 days) as compared to *T.arjuna* (43 days). ERR (%) was almost similar on both the food plants in both crops. Silk ratio (%) was 13.08 in *L. speciosa* and 13.38 in *T. arjuna*. During second crop, silk ratio ranged between 14.55 % in *T. arjuna* to 14.96% in *L. speciosa*. There was slight difference in the filament length in the cocoons harvested on *L. speciosa* and *T. arjuna* but non-breakable filament length was almost similar in *T. arjuna* (366.25m) and *L. speciosa* (364.75m). Grainage behavior in *L. speciosa* was at par with *T. arjuna.* Therefore, it is concluded that *L. speciosa* can be taken up under block plantation/mixed plantations in rainfed areas for tropical tasar culture as it is easy to propagate and fast growing as compared to *T.arjuna*. Moreover, it has an added advantage over *T. arjuna* that two consecutive silkworm rearing can be taken up on the same plantation.

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INTRODUCTION

The Indian tasar silkworm, *Antheraea mylitta* Drury is a natural fauna of tropical India. Wide distribution and polyphagy of this insect species had resulted in extensive variation in the population. As high as nineteen eco-races have been reported in this species which feed primarily on *Terminalia arjuna*, *T. tomentosa* and *Shorea robusta*. Apart from these genera a number of secondary food plants are also reported but the commercial silkworm rearing on these plants is not successful. Production of tropical tasar silk in India is very low and it constitutes about 4 per cent of the total silk production of the country. Low production can be attributed to (i) traditional method of silkworm rearing on tall trees in natural habitat, which exposes the larvae to a number of predators, parasites and diseases apart from natural vagaries (ii) slow growing nature of these plants which support only one rearing in a season (Anonymous, 2013). At this juncture a fast growing easily propagated plant which can be used within a short period of 2/3 years, and can support two consecutive rearing is needed. *Lagerstroemia speciosa* (L.) Pers. (Jarul) is a medium sized to large deciduous or semi-deciduous multipurpose tree up to 10 m tall with a rounded crown. It is distributed in Cambodia, China, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, Vietnam and Singapore. In India it is distributed more or less throughout the country especially in Assam, Bengal Deccan peninsula and foot of the Western Ghats. It is found at low to medium altitudes up to 2000 feet in comparatively open habitats, in disturbed or secondary forest, grassland, and along rivers. The habitat varies from well drained to occasionally flooded soil. It is resistant to fire. Due to the tree's dense and wide spreading root system, it is used in erosion control. The tree has been used in reforestation of degraded hills. It is also cultivated for ornamental purposes and as a roadside tree, boundary or barrier or support. The tree coppices freely and crown is

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usually bushy and spreading which makes it a suitable plant for large scale block plantation for Tasar silkworm rearing. Present study reports for the first time propagation technique of *Lagerstroemia specioisa* through cuttings and rearing performance of silkworm *Antheraea mylitta* D. on its foliage *vis a vis Terminalia arjuna*.

MATERIALS AND METHODS

Soft wood branch cuttings of *T.arjuna* and *L. speciosa* from the basal portion were collected in March from 6 year old trees grown in field gene bank at Central Tasar Research and Training Institute farm Ranchi, India. Cuttings from the shoots were made comprising 1st, 2nd and 3rd node. The cuttings were kept in 0.2 % carbendazim (a systemic fungicide) solution for 5 minutes and were planted in black poly bags of 30 x 15 cm size filled with river sand. These poly bags were kept in sub soil pits of dimension 6' x 3' x 3' made under shady place and covered with translucent polythene sheet. The polythene sheet was supported by wooden cross bars. Regular sprinkling of water in the sub-soil pits was resorted to maintain the humidity around 90 per cent. Water sprinkling was done 2–3 times in a day on the planted cuttings and walls of the sub - soil pit, depending upon the weather condition. Totally 100 cuttings were planted for each replication in each season to check the rooting during March, May, July, October and December to check the seasonal effect on the rooting. One year old saplings of both the species were planted in the field under 10x5' spacing and growth parameters were recorded after first and second year of plantation.

Biochemical estimation of chlorophyll, protein, phenol and proline were done in the leaves (Mahadevan, 1994). Silkworm rearing was conducted during July - August (First crop) and October- November (Second crop) on 6 year old medium sized bushes of *Terminalia arjuna* and *Legerstroemia speciosa* planted under 10' x 5' spacing in the field at Central Tasar Research and Training Institute, Ranchi. Basal application of recommended dose of fertilizer @100:50:50 kg of NPK/ha/year was done in the plants (Jolly, 1966 and Sengupta, 1986). Plants were pruned immediately (Mid August) after completion of first crop rearing to find out the availability of foliage for second crop rearing during October - November on the same bushes. Bivoltine commercial tropical tasar silkworm *Antheraea mylitta* D. race *Daba* was taken for evaluation of the rearing performance on the foliage of these tasar silkworm food plants.

Newly hatched healthy tropical tasar silkworm larvae were brushed on the foliage of *T. arjuna* and *L. speciosa* and reared till the harvesting of cocoons. Standard package of practices were followed during the entire rearing period (Sengupta, 1986; Singh and Thangavelu, 2001). First and second crop rearing was conducted on the same bushes in *L. speciosa* whereas, separate patch of *T. arjuna* plantation was utilized due to lack of sufficient foliage on the plants used for first crop rearing. Data on larval duration (days), mature larvae weight (g), effective rate of rearing (ERR% = 100 x total cocoons harvested / total larvae brushed), single cocoon weight (g), shell weight (g) and shell ratio (%) were recorded. Total quantity of cocoon shell (raw silk) production based on average ERR% values x shell weight was calculated (Das *et al*., 1992). Cocoons were also assessed for standard reeling parameters in Post cocoon Technology Laboratory at the Institute. Grainage behaviour was observed in the cocoons harvested out of silkworm rearing on *Lagerstroemia speciosa* as well as *Terminalia arjuna* during first crop 2014. Studies were conducted during 2013 and 2014 in both the seasons and averages of all the data were analyzed statistically.

RESULTS AND DISCUSSION

It is evident from the Table 1 that days taken for rooting varies in different season and maximum days taken for rooting was 45 days in *L. speciosa* and 60 days in *T.arjuna* in the cuttings planted during December. The rooting percentage did not differ much during various seasons in *L. speciosa* but the days taken for rooting increased significantly during December. However, the rooting percent in *T. arjuna* reduced drastically (52 %) in the cuttings planted during December. Height of one year old saplings of *L. speciosa* was more (80.13 cm) in comparison to *T. arjuna* (59.10 cm). Rehman,1977 performed various propagation trials with (a) teak (*Tectona grandis*), (b) gamar (*Gmelina arborea*), (c) jarul (*Lagerstroemia speciosa*), (d) koroi (*Albizia procera*), (e) kadam (*Anthocephalus cadamba* [*A. chinensis*]), and (f) chapalish (*Artocarpus chaplasha*). The reported that rooting response of stem cuttings was increased by treatment with IAA or IBA at 10 and 100 ppm in all species except (e) and (f), better results being obtained in April-May than in November-December. Induction of rooting in juvenile cuttings without any hormonal treatment has been reported by Kumar *et al*., (2005, 2011) in *T. arjuna and T. myriocarpa,* respectively and Piare Lal (2010) in various forest trees. They also concluded that the rooting percent was more during March and July as compared to October and December. Present results are in agreement with the above findings and have its significance that this propagation technique can be utilized for mass multiplication of elite clones in nurseries in all the seasons without any hormonal treatment. It is evident from the Table 2 that overall growth performance along with total leaf yield/plant of two year old plants of *L. speciosa* was higher than *T. arjuna* under 10 x 5' spacing in the field which makes it more suitable plant as compared to *T.arjuna* for block plantations.

Biochemical studies in the leaf shows that total protein, the main constituent of silk, was in the range of 31.08 mg/g (in *T.arjuna*) to 35.80 mg/g in (*L. speciosa*) [Table 3]. Total phenols were maximum in *L. speciosa* (5.6 µg/mg) and minimum (1.34 µg/mg) in *T.arjuna*. Proline contents, indicator of tolerance to drought were maximum (55.80 µmol/mg) in *L. speciosa* followed by 25.30 µmol /mg in *T.arjuna.* Results of the rearing performance on the foliage of *L. speciosa* and *T. arjuna* are presented in Table 4. In first crop single larvae weight at maturity was more in the worms reared on *T. arjuna* (36.53 g) as compared to *L. speciosa* (32.47g). The larval duration was 32 days in *L. speciosa* and 28 days in *T. arjuna*. Effective rate of rearing (ERR %) was almost similar in both the food plants (50 % in *L. speciosa* to 50.6 % in *T. arjuna*). The shell ratio in percent was slightly lower in *L. speciosa* (13.08) as compared to *T. arjuna* (13.38). Filament length and non breakable filament length were similar in the cocoons of *L. speciosa* and *T. arjuna.* Denier was slightly less in *L. speciosa* (8.48) as compared to *T. arjuna* (9.96).

Table 1. Comparative rooting performance of cuttings in *L. speciosa* and *T.arjuna*

Planting season	Number of cuttings planted	Days taken for initiation of rooting		Rooting per cent	
		L. speciosa	*T. arjuna*	*L. speciosa*	*T. arjuna*
March	100	25	30	95	80
May	100	25	30	95	80
July	100	25	30	95	75
October	100	35	45	85	70
December	100	45	60	80	52

Table 2. Growth parameters in first and second year plantation of *L. speciosa* and *T.arjuna* under 10x5' spacing in the field

Species		Growth parameters							Leaf moisture (%)		
		Plant height (cm)	Leaf yield/ plant (kg)	Number of Primary branches	Total length of primary branches (cm)	Number of Secondary branches	Total length of secondary branches (cm)	Internodal distance (cm)	Young	Medium	Coarse
L. speciosa	1st year	148.66	0.988	-	-	-	-	1.15	72.16	70.02	69.63
	2nd year	152.00	1.50	3.88	295.0	12.66	265.77	1.12	71.95	69.25	69.00
T. arjuna	1st year	149.00	0.717	-	-	-	-	1.22	70.25	68.65	66.38
	2nd year	150.00	1.10	3.55	263.0	9.00	297.00	1.14	70.12	68.00	67.23

Table 3. Means value of biochemical parameters for *T. arjuna* and *L. spe*ciosa

Species	Total chlorophyll (mg/g)	Total phenols (µg/mg)	Reducing sugar (µg/mg)	Non reducing sugar (µg/mg)	Total proline (µmol/mg)	Total protein (mg/g)
L. speciosa	1.07	5.6	6.10	6.80	55.80	35.80
T. arjuna	1.00	1.34	3.26	9.23	25.30	31.08
CD 5%	0.15	0.11	0.38	0.44	2.93	0.97

Table 4. Comparative rearing performance of *A. mylitta* D on *T. arjuna* and *L. speciosa.*

Parameters	1st Crop (July-August)		2nd Crop (October-November)	
	T.arjuna	*L.speciosa*	*T.arjuna*	*L.speciosa*
Larval duration(days)	28	32	43	52
Mature single larvae weight (g)	36.53 ± 0.08	32.47 ± 0.10	35.27 ±0.33	30.26 ±0.14
ERR (%)	50.6 ± 0.2	50.00 ± 0.3	69.44 ±0.15	70.83 ±0.11
Single cocoon weight (g)	8.92 ± 0.22	10.92 ± 0.58	14.14 ± 0.56	10.73 ± 0.39
Single shell weight (g)	1.05 ± 0.04	1.44 ± 0.12	2.04 ± 0.93	1.59 ± 0.10
Silk Ratio (%)	15.78 ± 0.22	13.11± 0.65	14.55 ± 0.65	14.96 ± 0.89
Total cocoon shell production	76.84 ± 2.04	76.39 ± 4.18	142.21 ± 6.57	113.00 ± 7.23
Filament length (m)	630.40 ± 30.15	695.42 ± 60.14	611.67±35.65	581.22 ±31.25
Number of breaks	1.33 ± 0.33	2.00 ± 0.52	1.66 ± 0.18	2.41± 0.33
Silk weight (g)	0.68 ± 0.03	0.64 ± 0.04	0.66 ± 0.023	0.68 ±0.06
Waste weight (g)	0.23 ± 0.01	0.31 ± 0.04	0.23 ±0.01	0.60 ± 0.03
Non-breakable filament length (m)	345.42± 43.06	340.17± 63.8	366.25 ±36.34	364.75 ± 53.75
Denier	9.96 ± 0.06	8.48 ± 0.29	9.84±0.021	9.48 ±0.17

During second crop rearing the larval duration was 52 and 43 days in *L .speciosa* and *T. arjuna*, respectively. Single larvae weight at maturity was 35.27 g in *T. arjuna* and 30.26 g in *L. speciosa.* The ERR % was almost similar on both the food plants as was observed during first crop. Silk ratio (%) ranged between 14.55 in *T .arjuna* to 14.96 in *L. speciosa*. There was a slight difference in the filament length in the cocoons harvested on *L. speciosa* and *T. arjuna*. The non-breakable filament length was almost similar in *T. arjuna* (366.25 m) and *L. speciosa* (364.75m). The Denier was 9.48 in *L. speciosa* and 9.84 in *T. arjuna*. The higher value of silk ratio might be due to better conversion of assimilated food in to raw silk by the silkworms reared on *L. speciosa.* Studies on grainage behaviour of the silkworms reared on *Lagerstroemia speciosa* reveal that an average of 210 eggs per 2 gram were obtained out of 10 couplings with hatching of 87.17 percent.

On the other hand, 208 eggs per 2 gram were obtained from the silkworms reared on *Terminalia arjuna* with hatching of 79.14 per cent. Tropical Tasar silkworm *Antheraea mylitta* D. is polypahagous and primarily feeds on *T. tomentosa* and *T. arjuna* (Srivastava *et al*., 2005). Several reports are available on the rearing performance of tasar silkworm on primary (*Terminalia tomentosa* and *T. arjuna*) and secondary food plants viz*., Anogeissus latifolia, Bauhinia variegata, Careya arborea, Hardwickia binata, Lagerstroemia parviflora, L. indica, Shorea robusta, Terminalia paniculata* and *Zizyphus jujube etc.* The results of these studies indicated that silk worms reared on *T. arjuna* and *T. tomentosa* gave better ERR (50%) then other plants where the average ERR was less than 20 percent (Anonymous, 1973, 1976, 1977, 1980; Srivastava *et al*., 2012). Cocoon crop performance through several rearing of *A. mylitta* D. larva fed on primary and secondary food plants

was also studied and it was concluded that the cocoon quantity and quality on the secondary food plants (Ber, Sal, Sidha and Dhawda) is much inferior in comparison to the primary food plants *i.e.* Arjun and Asan (Das *et al*., 1992). Studies also indicated that overall performance of rearing and grainage of *Antheraea mylitta* fed on *L. parviflora* was poor as compared to *T. tomentosa* (Reddy *et al*., 2010).

Present findings indicate that the silkworm rearing performance during first and second crop was almost similar on the plants of *L. speciosa* and *T. arjuna*. Silk ratio and filament length were almost similar in both the plants which may be due to the similar level of protein and moisture contents in the leaves of these species which make them palatable to silkworm. Slight increase in larval duration might be due to the high quantity of phenols in the leaves of *L. speciosa.* Phenols are considered as the ideal quantitative defense and found in abundance in *Terminalia* spp. and *L. speciosa*. Accoording to Loomis and Battaile (1966) the phenol – protein complexes are stable at acidic and neutral pH levels but dissociate at higher alkaline pH. Since the gut pH in *A. mylitta* is highly alkaline therefore, phenol in leaves might be utilized by the silkworm for its own benefit.

This has been corroborated by Pandey (1997) in *Antheraea proylei* J. fed on leaves of *Qercus* spp. He found that the presence of tannin in cocoon shell corresponded with leaf tannin contents and concluded that it seems reasonable that alkalinity in the larval gut reflects adaptation of *A. proylei* to tannin contents in oak leaves. High quantity of proline in *L. speciosa* indicates its ability towards drought tolerance. Accumulation of high quantity of proline in *L.speciosa* as compared to *T.arjuna* is an indication of drought tolerance of *L. speciosa*. Presence of high proline contents in barley leaves has been associated with drought tolerance (Stewart, 1980). Based on the findings, it is concluded that *L. speciosa* can be taken up under block plantation/mixed plantations in rainfed areas for tropical tasar culture as it is easy to propagate and fast growing as compared to *T.arjuna*. Moreover, it has an added advantage over *T. arjuna* that two consecutive silkworm rearing can be taken up on the same plantation.

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