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Tree Mulberry: The Future of Tropical Sericulture Farming

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Abstract

Mulberry is cultivated under varied agro climatic conditions for silkworm rearing and cocoon production in India. In Southern zones of India Andhra Pradesh, Karnataka, Tamil Nadu states were considered most traditional belts for Bivoltine sericulture. It was estimated that ¾th of the countries raw silk will be generated in these 3 states only. Though since decades the mulberry raised as low bush plantation accommodating 5000 to 6000 plants/acre in the geometry of 3'×3' and paired row spacing with [(2'×3')×5'] in irrigated conditions. But since 2-3 decades a lot of changes in the environment are noticed. Irregular monsoons, unprecedented down pouring, curtailed annual rainfalls compelling the farming community to go for planting of reduced quantity of plants in wider spacing maintained with improved irrigation methods (AMITs) with sustained quality and quantity of mulberry leaf. To study the impact of drought stricken atmospheric conditions among the sericulture farming community the present study was aimed.

Introduction

In India, mulberry is cultivated under varied agro climatic conditions for silkworm rearing and cocoon production. In Southern parts of India mainly Andhra Pradesh, Karnataka, Tamil Nadu, Telangana & Kerala states most popularly it is raised as low bush plantation with 3'×3' and Paired row spacing with [(2'×3')×5'] in irrigated conditions. Besides spacing, there is also considerable difference in the method and frequency of pruning. Spacing plays a significant role on crop yield. However, spacing of crop plants depends mainly on their growth behaviour and the magnitude of growth which is governed by edaphic and climatic factors. Light and aeration too plays an important role in photosynthesis of the plants and thus ultimately decides the dry matter accumulation and vegetative growth of the plants. Report says that growth and development of silkworm larvae, *Bombyx mori* L. and the economic characters of their cocoons are greatly influenced by the nutritional content of mulberry leaves. Proper spacing and consequent plant population per hectare has been recognised as one of the important factor in determining the leaf yield of unit area.

Mulberry leaf production is often limited by the amount of available soil moisture and it can be increased by providing timely irrigation. Researches reveal that irrigation increases leaf yield of mulberry plants by about 68%. Hence, increase in leaf yield and water productivity of mulberry is possible by improved methods of irrigation. The gap between water demand and supply is increasing year after year and declining in availability of ground water further aggravating the situation causing major threat to agriculture globally. Prolonged drought spell in South Indian states during summer period (March-

June) compelling the sericulturists in not only dwindling the mulberry cultivation but also either postponing to favourable seasons or reducing the silkworm rearing during summer. The reasons for low availability of irrigation water, irregular and inadequate rainfall, short spell down pouring > 50% annual rainfall in single or multiple days heavy drowning and inadequate ground water charge for bore wells leaving the recurrence of drought condition for prolonged period.

Sericulture Scenario in Southern India

Sericulture in Southern part of India such as Karnataka, Andhra Pradesh, Telangana, Tamil Nadu and Kerala is an age old practice. Out of the 5 states Karnataka is remaining on the top position in regard to the production of raw silk followed by Andhra Pradesh, Tamil Nadu, Telangana and Kerala. Long years ago (4 decades back) the South Indian sericultural farming community have been recommended paired row spacing [(2'×3')×5'] with 5,445 plants and 3'×3' spacing planting 4840 plants with low bush gardens imparting sufficient irrigation (1.5-2.5 lit./plant) through channel irrigation was the reality of sericulture. But slowly irregular monsoon and drastically reduced rainfall compelling the farming community thrive for water. Further, due to insufficient irrigation, farmers are not able to harvest required quantity of suitable quality leaf during drought stricken conditions leading to silkworm crop failures. Further, man power availability has become a big crisis due to urbanization. Narrow spacing minimized the deeply mechanised ploughing even for years leading hardpan formation causing superficial root system leading to wilting foliage and production of low and poor quality leaf (Figure 1).

Figure 1: Paired row spacing with unmanageable weeds & wilting of leaf in dry spell periods

Under the above adverse conditions some of the sericulture farmers in Southern parts of India are compelled to transform to tree mulberry farming in wider spicing such as 5'×5', 6'×6', 8'×3', 8'×5' & 10'×10' so on, convenient for mechanized cultivation maintaining either in rain fed conditions or semi-irrigated through the adoption of Affordable Micro Irrigation Technologies (AMITs) by providing plant wise manure, fertilizer and water in succeeding harvesting of quality leaf and performing bivoltine sericulture (Figure 2). As there is no any specific technology or package of practices for adopting tree mulberry in regard to ideal spacing for medium and marginal farmers, lacking awareness on pruning, training & maintenance plants followed recommended doses of manure and fertilizers for the production of uniform quality and enhanced leaf and cocoon production. Hence, it is necessary to develop a recommended technical now how on tree mulberry to combat with the drought stricken conditions by the South Indian farming community.

Figure 2: Tree mulberry farming prevailing among the sericulture farming community

Necessity of Tree Mulberry Farming

Though Dandin *et al*. (2003) gave suitable package of practices for low bush type of mulberry farming in narrow spacing like 3'×3' and [(2'×3')×5'] but as such no recommendations were exists for Tree mulberry farming in wider spacing. In the recent past, Sudhakar *et al.* (2018), drawn some conclusions on package of practices for tree mulberry. From the results noticed that tree mulberry planted in 8'×4' spacing with 1364 plants yielded 13.4% (27.28 mt/ac/yr) increased yield compared to paired row spacing. However, the other tree forms *viz.* as 8'×5' (with 1364 plants) registered condensed levels of leaf yield (-9.3%) followed by 10'×4' (1091) with -9.3%, 10'×5' (873) with -27.4%, whereas 10'×10' (437) recorded economically not viable leaf yield (-63.7%). However, if consider economic viability on C:B ratio of maintenance of mulberry plantation and silkworm rearing, it is noticed that 10'×5' spacing registered with higher C:B ratio (2:7.90) followed by 8'×4' (2:5.50), 8'×5' (2:4.90),

10′×4′ (2:4.90) compared to paired row spacing (2:3.97) & 3′×3′ spacing (2:3.77) whereas least C:B ratio was recorded in 10′×10′ (2:3.90) convincing that tree mulberry in wider spacing (10′×10′) is uneconomical and not viable among the medium and marginal farming community (Table 1, Figure 4). Literature states that the relation of plant density and yield was variable if '*decline plat populations declines yield'*. Studies carried out elsewhere have indicated improved plant growth and increased leaf yield due to higher crown (pruning) height against the low height followed by leaf quality parameters such as leaf moisture and total chlorophylls recorded higher in tree mulberry farms compared to paired row spacing indicating their most suitability for silkworm rearing thereby production of quality cocoon (Fotadar *et al.,* 1995).

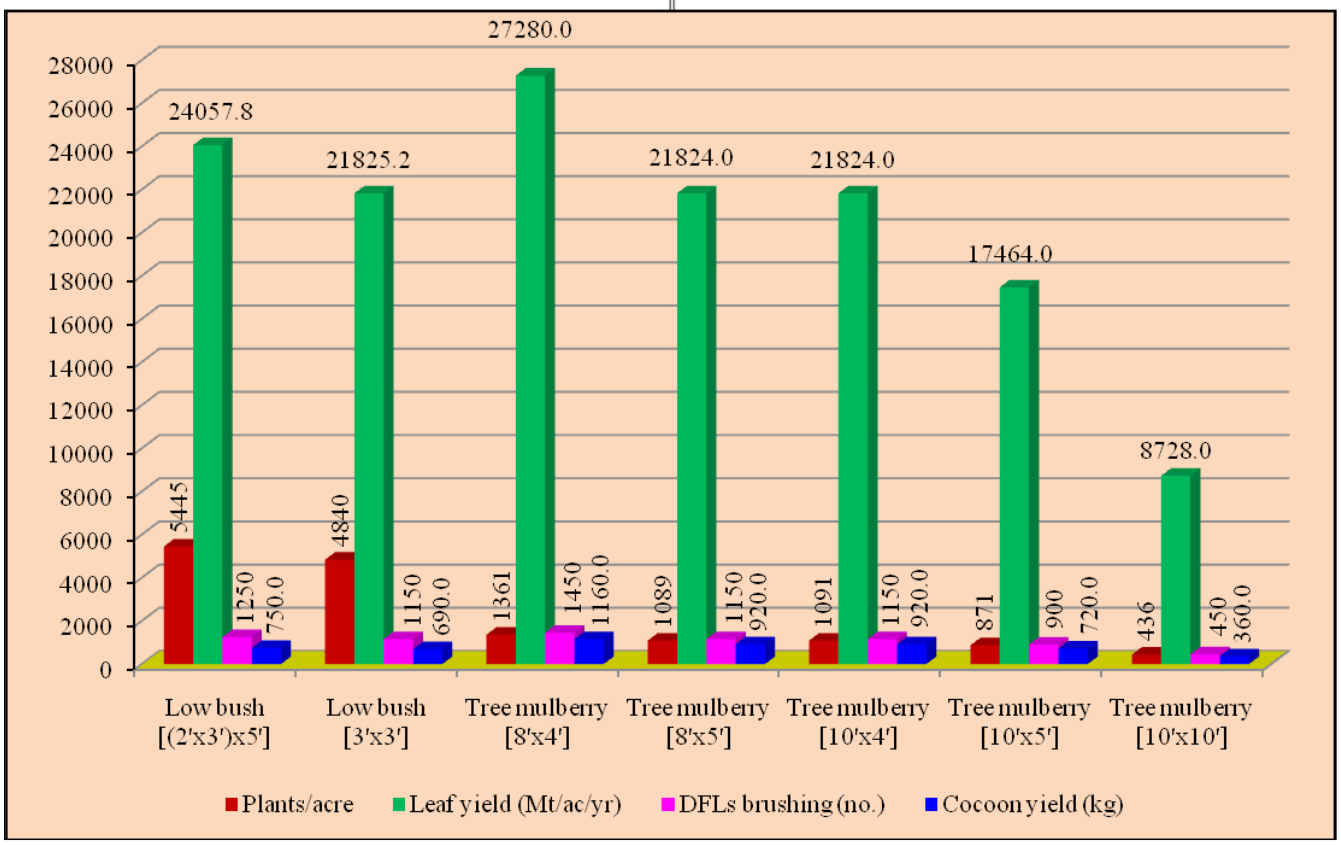

Figure 3: Leaf yield, no. of DFLs brushing, cocoon yield/ac/yr and no. of plants/acre as influenced by the mulberry planted in varied geometries

How & When to do Tree Mulberry Plantation

• With the onset of monsoon (June-July) land preparation and plantation can be planned.

• 5-6 months old well matured mulberry saplings of V_1 or G_4 varieties were selected for plantation.

• Saplings were planted in 2 to 2.5 ft deep pits supplementing with >1 kg farmyard manure (FYM).

• Ideal spacing for tree mulberry is 8′×4′ 8′×5′, 10′×4′ & 10′×5′ planting with around 800-1500 plants/acre for sustainable and economically viable tree farming.

• After plantation saplings trimmed to 1.5 to 2.0 ft height from the ground level for convenient operation even after 10-15 years.

• Due to incessant rains of monsoon plants will establish within 5-6 months. During the establishment the plants trained giving crown form removing unwanted side branches from the bottom.

• If the maintenance appropriate first harvest can be undertaken 6 months after plantation followed every 70 days interval as scheduled practice followed by imparting harvesting of 5 crops/year schedule.

• Once the trees are well established and started yielding 5-8 kg leaf/plant the recommended NPK @ 28:11:11 kg/ac/crop by supplementing with 140:70:19 kg Ammonium sulphate (AS), Single Super Phosphate (SSP) & Muriate of Potash (MOP) may be imparted along with 10 MT FYM/ac/yr in 2 splits.

• Once tree mulberry stabilized for anticipated yield levels (@ 5-8 kg/plant) chemical fertilizers can be reduced to a tune of 50% by plant wise application avoiding wastage.

Advantages of Tree Mulberry Plantation

• Tree mulberry withstands drought conditions due to its firm tree form and deep root system.

• Economizes manure & fertilizers preventing wastage and perform well in all seasons even under dearth stricken ambiance.

• Convenient for mechanization, minimizes manpower drudgery in cultivation and irrigation (due to use of AMITs).

• Offers uniform, healthy & enhanced quality leaf benefitting Bivoltine sericulture with enhanced gradable quality cocoon production with superior market rates.

• Occurrence of minimum pest & diseases due to adequate aeration and defiant tree habitat.

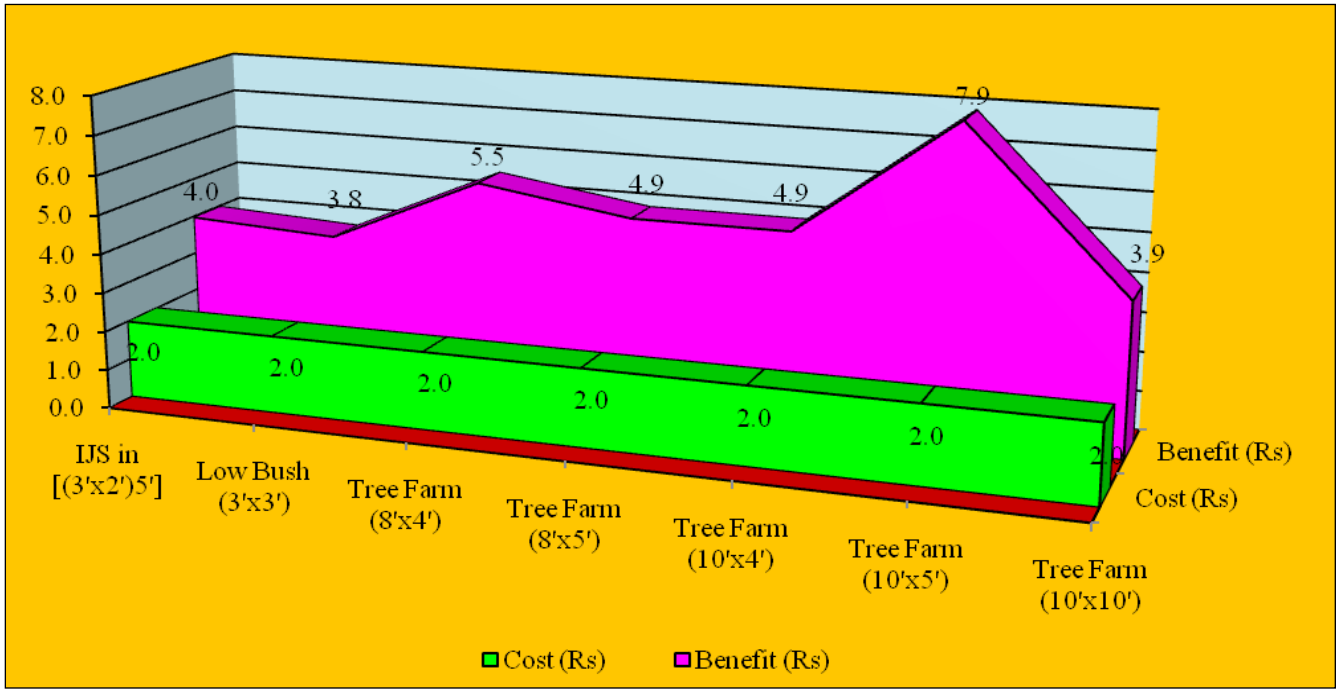

Figure 3: Leaf yield, no. of DFLs brushing, cocoon yield/ac/yr and no. of plants/acre as influenced by the mulberry planted in varied geometries

Table 1: Cultivation and cost of production of bivoltine cocoon production under varied geometries of mulberry (ac/yr)

Sl. No.	Activity/ Inputs/ Materials	Quantity (No./MT/kg/ac/yr)		Rate (Rs.)	Plantation in Varied Geometries						
		Paired Row	Tree Farm		Low Bush [(3'×2')5']	Low Bush (3'×3')	Tree Farm (8'×4')	Tree Farm (8'×5')	Tree Farm (10'×4')	Tree Farm (10'×5')	Tree Farm (10'×10')
1	No. of Plants/acre	-	-	-	5422	4850	1364	1091	1091	873	436
2	Farmyard Manure (FYM)/MT	10 MT	5 MT	1250.0	12,500	12,500	6250	6250	6250	6250	6250
3	AS:SSP:MOP	100%	50%	13/8/12	13292.0	13292.0	6646.0	6646.0	6646.0	6646.0	6646.0
4	Application of FYM (Rs. 250.00 per MD)	7 MD	5 MD	250.00	1750.0	1750	1250.0	1250.0	1250.0	1250.0	1250.0
5	Application of Chemical fertilizers	4 MD	3 MD	250.00	1000.0	1000.0	750.0	750.0	750.0	750.0	750.0

Table 1: Continue...

Sl. No	Activity/ Inputs/ Materials	Quantity (No./MT/kg/ac/yr)		Rate (Rs.)	Plantation in Varied Geometries						
		Paired Row	Tree Farm		Low Bush [(3′×2′)5′]	Low Bush (3′×3′)	Tree Farm (8′×4′)	Tree Farm (8′×5′)	Tree Farm (10′×4′)	Tree Farm (10′×5′)	Tree Farm (10′×10′)
6	Tractor Plough (by cultivator) (@ Rs. /ac)	5 times	5 times	1000.00	5000.0	5000.0	5000.0	5000.0	5000.0	5000.0	5000.0
7	Channel making by tractor (@ Rs. /ac)	5 times	-	800.00	4000.0	4000.0	-	-	-	-	-
8	Irrigation: (Channel / Drip)	40 MD	25 MD	250.00	10,000.0	10,000.0	6250.0	6250.0	6250.0	6250.0	6250.0
9	Shoot harvest (MD)	80 MD	80/20	250.00	20,000.0	20,000.0	20,000.0	20,000.0	20,000.0	20,000.0	5000.0
10	Tax Paid on Land (Rs. 100 /ac)	-	-	100.00	100.0	100.0	100.0	100.0	100.0	100.0	100.0
11	TOTAL (Rs. in Lakh)	-	-	-	0.68	0.68	0.46	0.46	0.46	0.46	0.30
12	Leaf yield (mt/ ac/yr) (Figures in parenthesis indicates increase/ decrease of leaf yield over paired row spacing)	-	-	-	24.06	21.83 (-9.3%)	27.28 (13.4%)	21.82 (-9.3%)	21.82 (-9.3%)	17.46 (-27.4%)	8.73 (-63.7%)
13	Cost of leaf (Lakh) (@ Rs. 5.00 per kg)	-	-	-	1.20	1.09	1.36	1.09	1.09	0.87	0.42
14	Cost:Benefit Ratio of leaf production	-	-	-	1:1.8	1:1.6	1:3.0	1:2.4	1:2.4	1:1.9	1:1.4
15	Silkworm Rearing/ acre:										
16	No. of DFLs to be brushed/ ac/yr	-	-	-	1250	1150	1450	1150	1150	900	450
17	Cost of DFLs (chawki worms/ 100 DFLs)	2000.00	2000.00	-	25,000	23,000	29,000	23,000	23000	18000	9000
18	Cocoon Yield (kg/ 100 DFLs)	60 kg	80 kg	-	750 kg	690 kg	1160 kg	920 kg	920 kg	720 kg	360 kg

Table 1: Continue...

Sl. No	Activity/ Inputs/ Materials	Quantity (No./MT/kg/ac/ yr)		Rate (Rs.)	Plantation in Varied Geometries						
		Paired Row	Tree Farm		Low Bush [(3'×2')5']	Low Bush (3'×3')	Tree Farm (8'×4')	Tree Farm (8'×5')	Tree Farm (10'×4')	Tree Farm (10'×5')	Tree Farm (10'×10')
20	Input cost of rearing (Lakhs) (@ 25%)	-	-	-	65,625	60,375	1,45,000	1,15,000	1,15,000	90,000	45,000
21	Expenditure on silkworm rearing (17+20)	-	-	-	90,625	83,375	1,74,000	1,38,000	1,38,000	1,08,000	54,000
22	Net Gain due to rearing (Lakhs)	-	-	-	1,96,875	1,81,125	4,35,000	3,45,000	3,45,000	2,70,000	1,35,000
23	Comparative gain over IJS spacing	-	-	-	-	- 8.00%	120.95%	75.24%	75.24%	37.14%	- 31.43%
24	C:B Ratio of varied spacing	-	-	-	1:2.17	1:2.17	1:2.50	1:2.50	1:2.50	1:2.50	1:2.50
25	Net gain due to mulberry & SW Rearing	-	-	-	2:3.97	2:3.77	2:5.50	2:4.90	2:4.90	2:7.90	2:3.90

Man Day (MD) = Rate per MD is @ Rs. 236.00, rounded of to 250.00 per MD.

*Tractor ploughing: @ Rs. 2,500.00 /ha for paired row spacing low bush farm, whereas Rs. 2,000.00 /tree mulberry farm.

Irrigation: For flood: @ 3 MD/irrigation × 10 times per crop × 5 crops); Drip: @ 1 MD per irrigation × 10 times × 5 crops.

Fertilizers: Rec. dose of AS, SSP & MOP & FYM (350:140:140 kg/ha/yr & 20 mt/ha/yr) applied in IJ spacing; whereas the same reduced to 50% in tree mulberry.

**DFLs brushing: IJ spacing @ 875 DFLs/ha/crop; 8'×3' spacing @ 625 DFLs/ha/crop; 8'×5' spacing @ 500 DFLs/ha/crop; 10'×10' spacing @ 250 DFLs/ha/crop.

Conclusion

Therefore, the tree farm of mulberry is an imperative to not only for enhanced uniform quality and assured leaf yield and cocoon production but also to combat with prevailing acute drought stricken climatic conditions. With the above inferences the South Indian Tropical sericulturists are advised to follow the above depicted package of practices for their benefit and uplifting their socio-economic conditions but also supporting the Indian economy through the gradable Bivoltine raw silk production.

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