MULBERRY CULTIVATION AS HIGH BUSH AND SMALL TREE IN HILLY REGIONS

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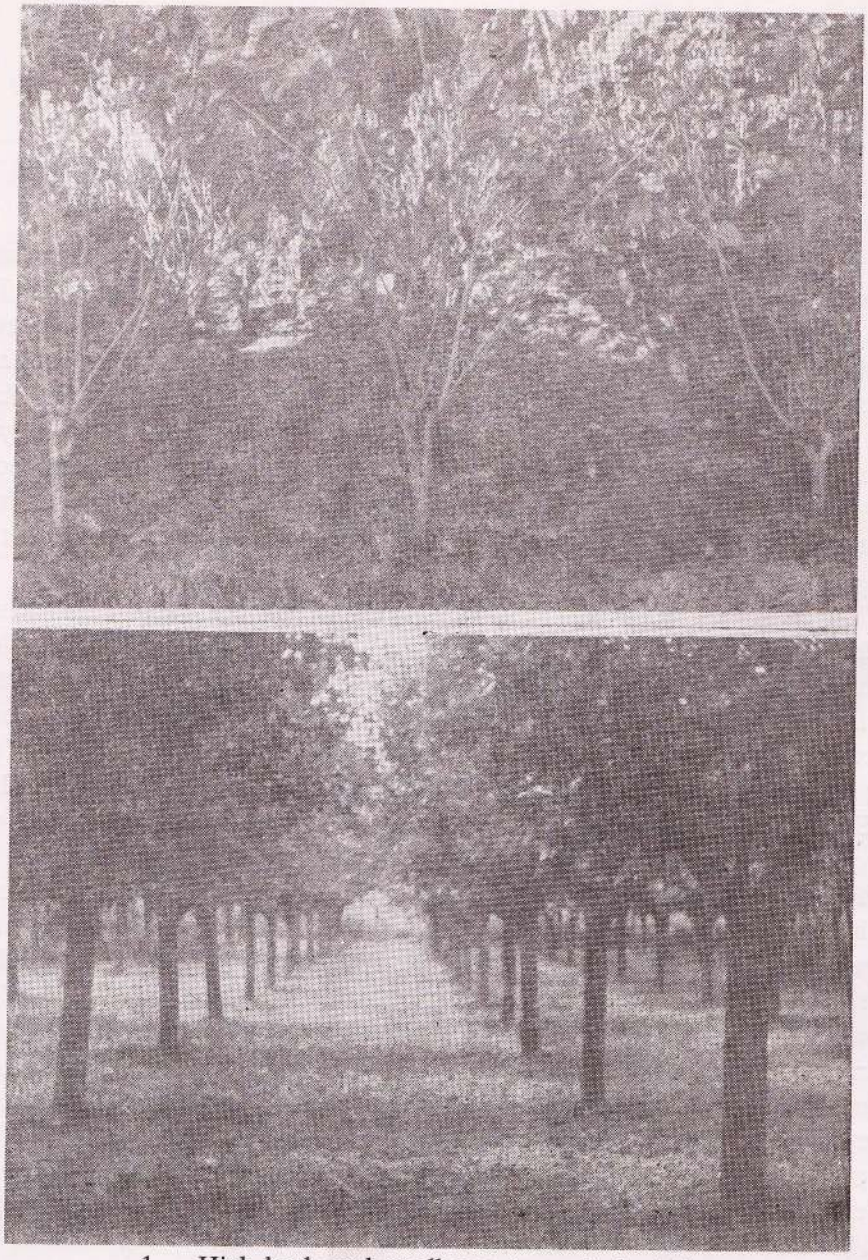
INTRODUCTION

Mulberry a basic raw material for sericulture industry is a deciduous or moist deciduous tree species found naturally distributed along the foot hills of Himalaya right from J & K to North Eastern States upto an elevation of 9000' MSL. Genus *Morus* to which mulberry belongs forms a dominant forest flora in parts of J & K; Kumaon and Garhwal hills of Central Himalaya and in most of the North Eastern forests extending upto Unani region. In fact, in most of these forest areas, silkworms are reared by local people only from leaf available in these forest trees. In addition, mulberry is found in most of the public places, court yard of the houses as a popular fruit tree.

Owing to the fast spread of sericulture to most of the states with heterogeneous agroclimatic conditions, different cultivation methods have been evolved and being practiced. This has become possible only because of the wider adaptability of mulberry plant to different agroclimatic conditions and cultural practices. At present mulberry is being cultivated as a low bush with comparatively closer spacing of 2′ x 6″ to 3′ x 3′ in plains of South India and West Bengal to obtain maximum leaf yield and easy harvest. On the other hand, mulberry is cultivated as a large/medium tree with wider spacing of 10′ x 10′ to 20′ x 20′ in Jammu and Kashmir area. Of late, dwarf tree plantation with 5′ x 5′ and 5′ x 10′ spacing is becoming popular in this state (Fig. 1). In temperate countries like China (Northern part) Japan and Korea, mulberry is cultivated as high bush with closer spacing between plants and wider spacing between rows. The common spacing adopted is 0.6 x 1.5 - 2.0 m. In USSR, it is reported that mulberry is grown as small/medium tree with wider spacing and in between, cotton is cultivated. In addition, mulberry trees are also planted all along the boundaries of farm and irrigation channels. Hence, mulberry is grown in different forms in different parts of the world depending on the climatic conditions and cultural practices.

Growing mulberry as tree in India though not new, has several advantages and seems to be quite promising. As 50% of the area under mulberry is rain dependent for its moisture requirement, growing mulberry as high bush/low tree helps the root system to develop more extensively and deeper into the soil. Problem of cultivation of large area of non-



1. High bush and small tree type of plantation.

areable land available in hilly terrains of the country especially in Western Ghats and Central India can be easily solved by cultivating mulberry as a small/medium tree. Mulberry can grow on marginal lands and produce

large amount of leaf which will help the rural mass to take up sericulture. In addition, it can provide sufficient fuel material and effectively check the soil erosion. Hence mulberry can as well be included as one of the component in social forestry and water shed management schemes. Finally planting mulberry on farm road sides, on the bunds of farm ponds and fish ponds; in the courtyard of farm/dwelling house; all along the boundries of field etc., will help in getting additional amount of suitable leaf for late age worms and also fuel material. Realising the above merits, growing mulberry as a small tree is gaining momentum. Of late, Central Silk Board and various State Sericultural Departments are coming forward to take up this programme in water shed management, social forestry and development of non-aerable lands.

At present mulberry is extensively grown as small bush with closer spacing and suitable cultural practices have been evolved for this. On the other hand, there is not much information about growing mulberry as high-bush/small or medium tree and cultural operations to be followed. Hence, this document is prepared to provide some guidelines covering all the aspects right from land selection to economics. The suggestions may not be applicable in toto to all the agroclimatic or cultural zones. However, with suitable modifications this will serve by and large the main object of growing mulberry as high bush or small tree.

Selection of site and land preparation

Mulberry can be grown in various topography and soil types. Flat, elevated lands are more suitable for growing mulberry as bush with closer spacing, whereas tree plantation can be raised in all types of topography except steep slopy terrains and submersible marshy lands. If the land is having gentle slope, it can be levelled with minor land shaping and providing suitable type of bunds across the slope. If the degree of slope is more, contour bunding, terrace planting or contour line planting can be adopted. In any case, soil cutting and shifting should be kept at minimum as these soils are more vulnerable to erosion. In more slopy areas, platform for individual plants on contour lines is more suitable as the same involves less soil cutting.

Though mulberry can be grown in any type of soil, well drained deep clay loam soils are more suitable for luxurient growth. Soil pH of 6.2 to 6.8 is considered optimum. However, alkaline soils with high pH can be rectified by application of gypsum followed by flooding and draining

away the water. Application of large amount of green manure will also help in reducing the alkalinity. Similarly, acidic soils can be corrected by application of required amount of lime or dolomite before cultivation.

Spacing and preparation of pits

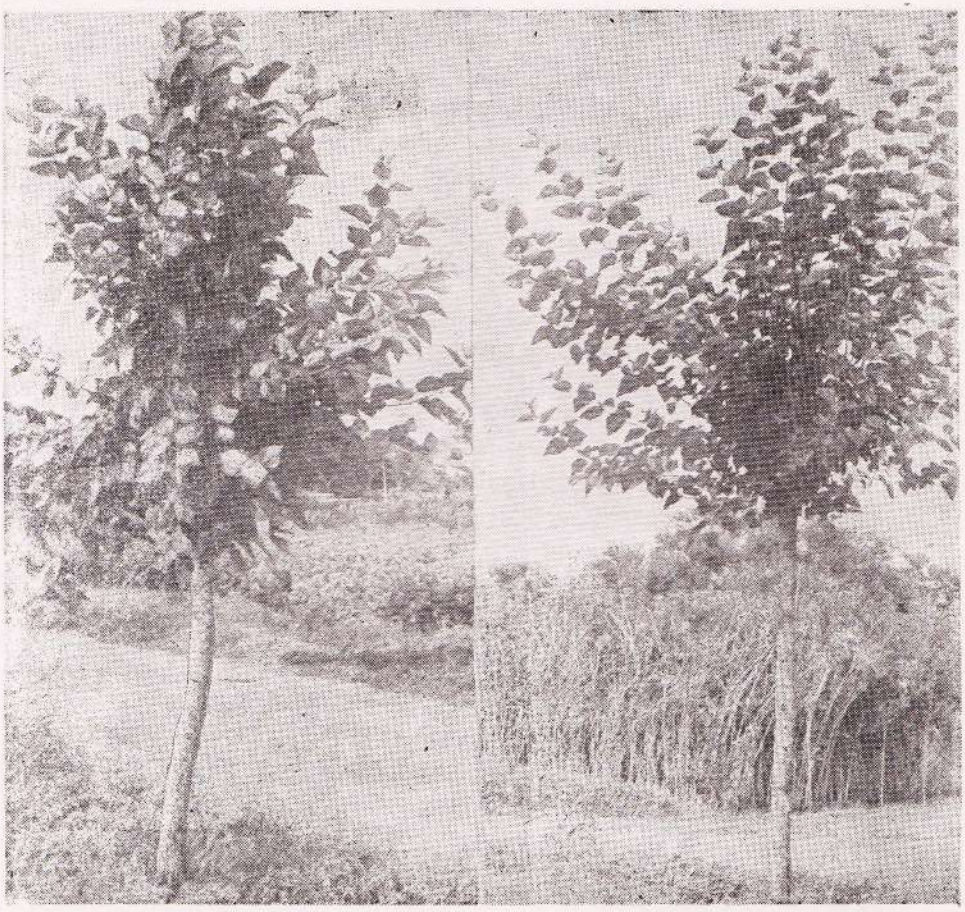
Spacing for tree planting depends on soil topography, extent of land available for cultivation and training method. In case of lands with gentle slope, 5′ x 5′ spacing can be adopted. In case of slopy lands, 5′ from plant to plant and 10′ from row to row is suggested. Plants must be planted in rows across the slope. In large extent of forest lands with undulating surface, 10′ x 10′ spacing is more suitable. Generally, in smaller holdings of less slope, 5′ x 5′ spacing and in larger areas of undulating or slopy terrain 5′ x 10′ or 10′ x 10′ spacing can be adopted. Number of plants/ha and type of pits required etc., are given in Table-1.

Land preparation for tree planting is much easier than bush cultivation. For tree plantation, depending on the spacing, spots for pits are to be marked with pegs. In case of deep textured loose soils, 45 x 45 x 45 cm and in hard shallow soils, 60 x 60 x 60 cm size pits can be dug. Pit preparation should be started soon after receipt of pre-monsoon showers. While preparing pits, all root stocks and other plant material must be completely removed. Before a week of planting, pits must be filled with a mixture of well decomposed farm yard manure or compost and soil. For each pit 5 kg (one iron pan) of FYM or compost must be applied. If the soil is clay, about two iron pans of sand or red earth should be incorporated to each pit. As most of the hilly/forest soils are acidic with low pH, application of lime is necessary. 500 gms of agricultural lime can be incorporated into each pit along with farm yard manure.

Variety and Planting Material

Kanva-2 (M5) variety in South India, BER Sl (Mandalya) in West Bengal (Fig. 2) and Sujanpur-5 in North are found suitable for growing as trees and can form good crown by proper training. These varieties are good in growth and give high leaf yield of good quality. In addition, these are found amenable to vegetative propagation. Apart from these varieties, some new varieties are also being tried for their suitability as trees. The same will be made available to farmers soon after the completion of trial.

For raising trees or high bushes of mulberry, sapling planting is found most suitable. Saplings of 5 months age with 5′-6′ height can be used for planting. As saplings have a well developed root system, they



2. Variety Kanva-2 and Ber Sl

establish quickly and form sufficient canopy in a short period. Root system also grows fast and to the deeper layers of soil which will help in withstanding moisture stress. Saplings must be raised 5-6 months earlier to planting. February month is most suitable for this purpose. Flat elevated land with good drainage must be selected for preparation of nursery beds. The site must have an assured irrigation source as the nursery beds require regular watering till June. In closer spacing of 5′ x 5′, 4350 plants are required for one hectare. Hence, arrangements must be made to raise 5000 saplings. 8′ x 4′ size bed can accommodate 192 cuttings. Totally about, 26 beds of this size are required to raise enough saplings. Nursery site must

be given a deep digging and all the root/grass stocks must be removed. Beds of 8′ x 4′ size must be marked with bunds and every nursery bed must be provided with channel. 20 kg (4 bandli) of well decomposed Farm Yard Manure and 50 kg (10 bandli) sand or red earth must be applied followed by second round of digging to mix the FYM and sand into the soil. Seed cuttings must be 6″-8″ in length with 3-4 healthy buds. Cuttings must have clean cut on both ends. Cuttings must be planted in 8″ x 3″ spacing. After one month of planting, first round of weeding must be given and after two months a booster dose of urea or suphala at the rate of 500 g per bed must be applied. Regular irrigation at an interval of 5-6 days must be given. Saplings will attain a height of 5′ - 6′ after 5 months and ready for replanting (Fig. 3). While uprooting, enough care must be given and no damage should be caused to the base. Saplings must be planted immediately after uprooting without long storage.

Planting Season and Method

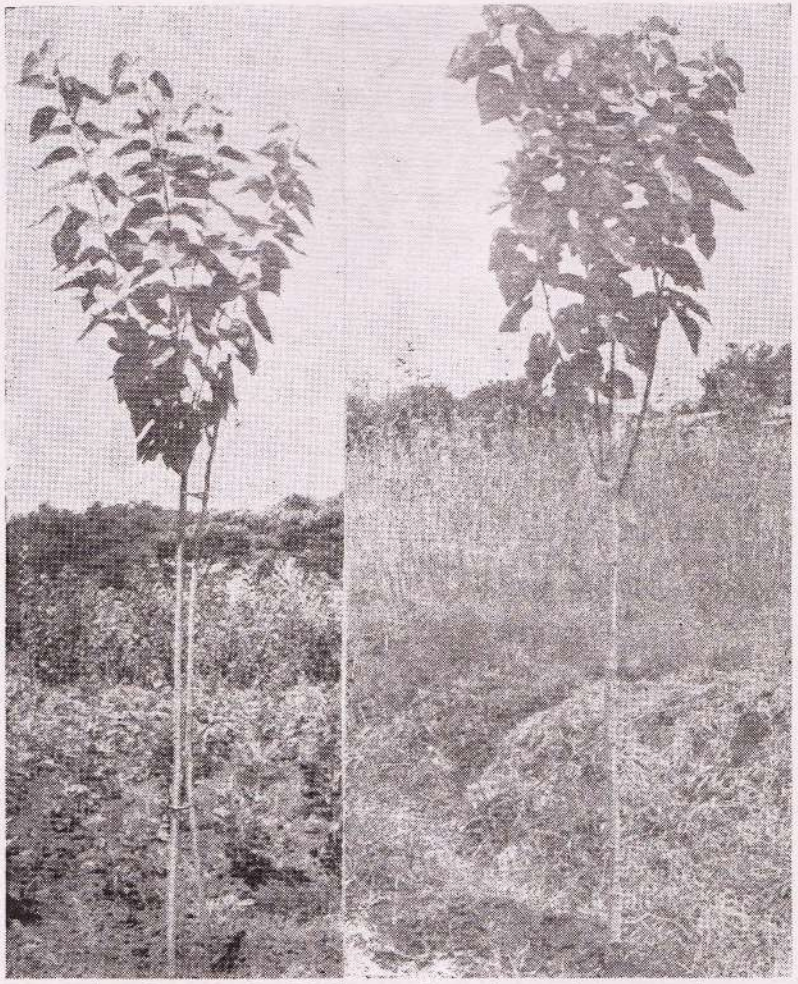
Planting should be started only after the regular onset of monsoon so that there will be assured moisture supply after planting. One sapling must be used in each pit for planting and it should be placed deep and

3. Saplings suitable for plantation.

straight in the centre of the pit by removing some soil. Soil around the sapling must be pressed firmly. As saplings are 5′ - 6′ tall they should be protected from wind by providing a support of a stick and tied to it properly (Fig. 4). Soon after the planting, pot watering has to be attended if there are no rains on the following days.

After care of plantation

As planting is done during monsoon season, they get established quickly. Sprouting starts after 10-15 days of planting and upto one month all the buds must be allowed to sprout. After one month, all the lower



4. Support for Mulberry plants for straight growth.

buds except the top 5-6 should be removed carefully without damaging the bark. Weeds grown around the plants should be removed regularly at least once in a month by the help of weeding sickle. Pot watering must be attended in case of failure of rains during this period. After three months of planting and 2nd round of weeding, about 25 gms of Suphala should be applied in a trench made around each plant and the same should be closed. 2nd dose of fertilizer should be given in the form of urea after 5-6 months of planting. About 25 gms of urea is sufficient for each plant. 2nd dose of fertilizer must be given before the cessation of monsoon when there will be enough moisture in the soil.

During the first year of planting, all the lower bunds should be removed regularly. Plants must be protected from grazing animals. All around the plantation, green fencing of *Gliricidia* or *Durantha* must be raised. Barbed wire fencing can also be fixed if possible to prevent the entry of stray cattles, sheeps and goats which cause considerable damage to plants. Details of cultural operations, expenditure etc., for planting and establishment of one ha of plantation are given in Table-1.

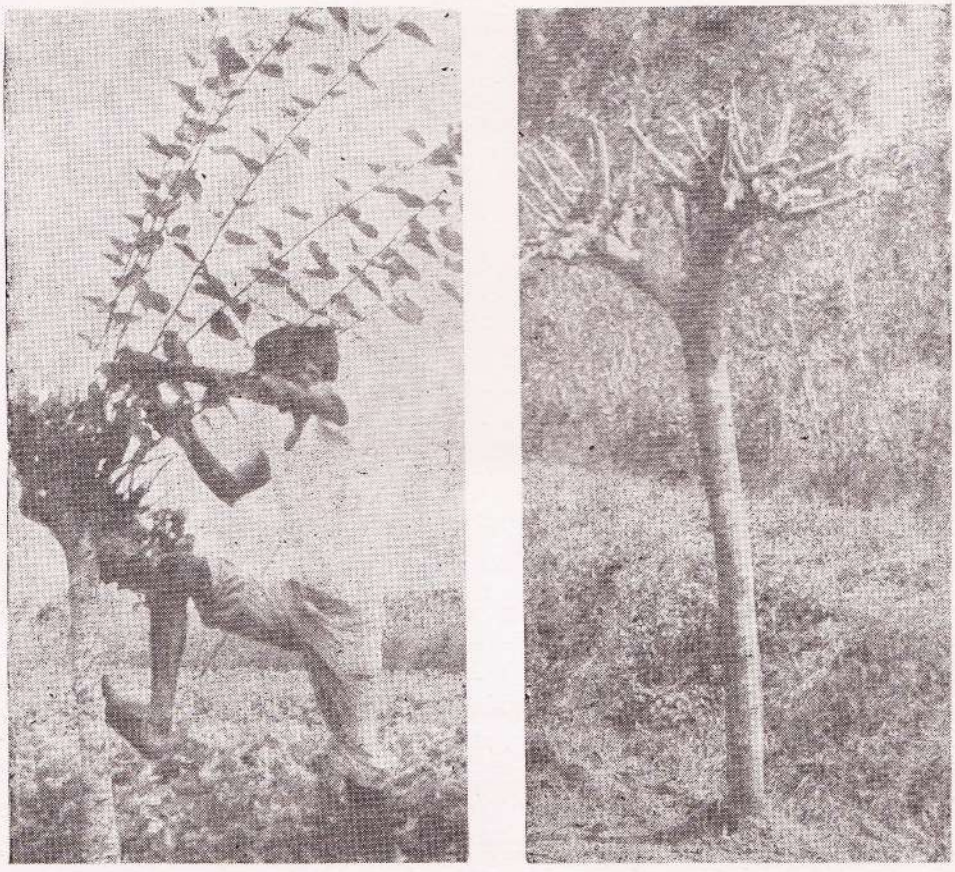
Cultural Operations during 2nd, 3rd and 4th year of plantation

Plants will attain a height of 8′-10′ after one year of planting. Before the onset of monsoon, plants must be given 1st pruning at a height of 3′ from the ground in closer spacing of 5′ x 5′ and at a height of 5.5-6′ in wider spacing of 5′ x 10′ and 10′ x 10′ leaving 3-4 buds on each primary branch (6-8 inches) as shown in Fig. 5. Soon after pruning, 5 kg (one iron pan) of well decomposed FYM or compost must be applied at the base followed by thorough digging around each plant. After digging, a basin of 2′ radius around each plant must be formed for water retention. After one month of pruning when buds start sprouting, chemical fertilizers must be applied. 1st dose of NPK complex fertilizer at the rate of 30 g/plant should be given in a trench of 8″-10″ deep around each plant. 2nd round of weeding must be given after two months of pruning. 2nd dose of fertilizer must be given in the form of urea at the rate of 30 g/plant after taking second leaf harvest.

Soon after pruning, the inter plant/row area can be given a light ploughing/digging and green manure crops like Sunhemp or Dhaincha or pulse crops like Horsegram, cow pea or Green gram can be grown as detailed in preceeding paragraph (Fig. 6).

Leaf Harvest

First leaf harvest can be obtained after 70 days of pruning. Leaves must be harvested only by leaf plucking and terminal buds should not be

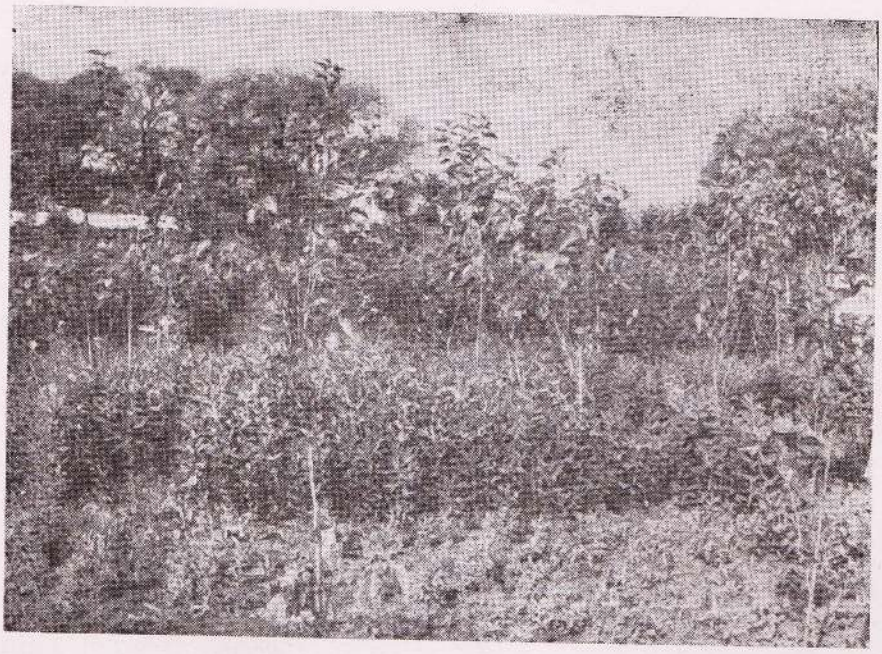


5. Pruning of Mulberry Plants

removed during 1st and 2nd harvests. In a similar way 2-3 more leaf harvests can be obtained at an interval of 80-90 days during these years. All the harvests must be only through leaf plucking. Cultural operations, amount of leaf available, harvest cost etc., during 2nd, 3rd and 4th year of planting are given in Table-2 along with approximate returns.

Maintenance and Leaf harvest from 5th year onwards

Tree plantation starts giving full potential yield from 4th year onwards. Each tree can be pruned twice a year at an interval of 6 months.

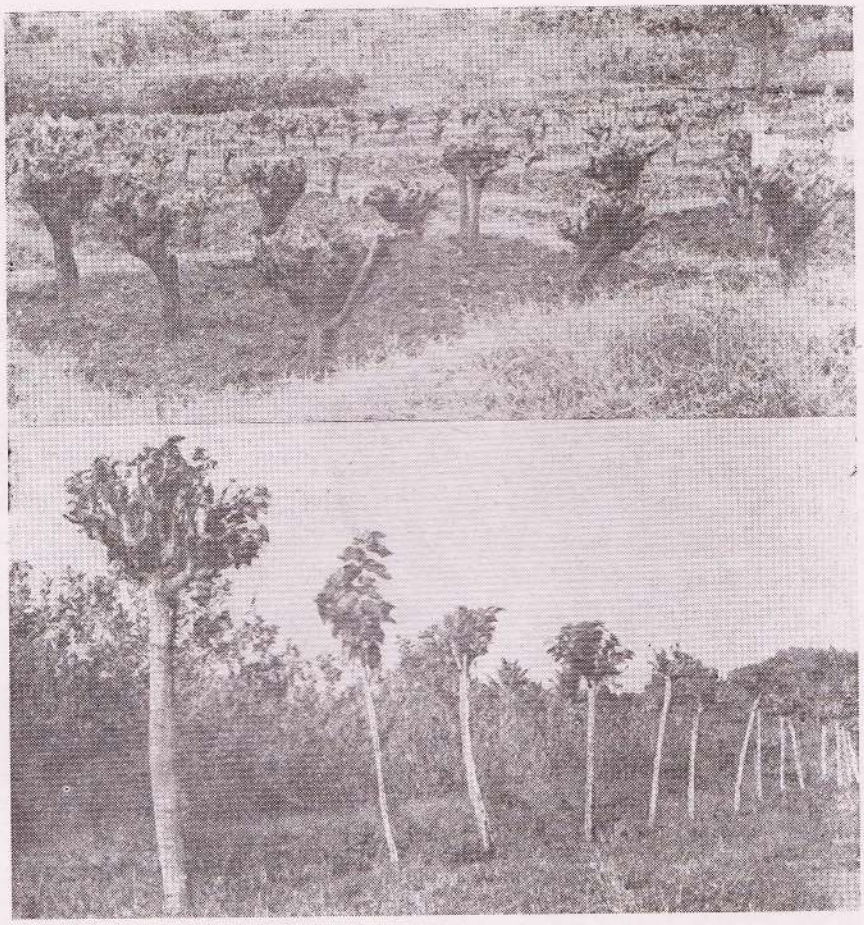


6. Mixed cropping in new plantation.

First pruning can be given during June after the onset of South West monsoon and 2nd pruning during last week of October or 1st week of November before the cessation of monsoon. In closer planting of 5' x 5' spacing, stump height of 2'-3' can be maintained as shown in Fig. 7A. Secondary branches must be pruned at a height of 6″-8″ leaving 3-4 buds from branching point. In small tree type with 5′ x 10′ or 10′ x 10′ spacing, plants must be regularly pruned at a stump height of about 5′-5.5′. Here also 3-4 buds must be left on secondary branches (Fig. 7B). While pruning, the cut ends and the bark should not be damaged.

Manure and Fertilizer Application

Soon after 1st pruning in June, 5, 10 and 15 kg of well decomposed FYM or compost must be applied around every tree in 5′ x 5′, 5′ x 10′ and 10′ x 10′ spacing respectively followed by digging. While digging roots should not be damaged. After digging a basin of 2′ radius must be formed around each tree for conserving enough moisture. Chemical fertilizer can be applied twice in a year after a month of each pruning. First dose should be NPK complex fertilizer and 2nd dose should be only nitrogenous fertilizer i.e., urea or calcium ammonium nitrate (CAN) at the rate



7A. Crown height in high bush type of plantation.

7B. Crown height in small tree type of plantation.

of 50, 60 and 75 g/plant depending on spacing. Fertilizer has to be applied in a 8″-10″ deep trench around the plant at a radius of 2′. If the soil pH is low, lime/dolomite application should be practiced every year along with farm yard manure.

Weeding and Intercultivation

Base of each plant to a distance of 2′ must be kept weed free. During summer, this area must be kept covered with the dry grass and dried parts of other weeds to prevent the surface evaporation. This will increase moisture holding capacity and soil fertility.

Intercropping

As large amount of free area is available in between plants and rows, this area can be well utilized for growing green manure crops viz., Dhaincha, Sunhemp or grain yielding leguminous crops like Horsegram, Cow pea, Green gram etc. These crops can be grown in between the plants either by line sowing or by broadcasting. The best time for sowing is South-West Monsoon season (June). Soon after 1st annual pruning, seeds can be broadcasted followed by light digging or hoeing or sown in plough furrows. Green manure crops should be uprooted and mulched back to the soil before the onset of flowering and leguminous grain crops can be harvested after ripening of pods. Intercultivation of such crops help in enriching soil fertility by providing organic matter and also by root nodulation bacteria. This practice will effectively check the weed growth and reduces soil erosion. Sizeable amount of grains and dry podder can be obtained from grain legumes. In certain areas depending on local practice, short duration vegetables, coriender, menthi, radish or mustard can also be grown. However, growing leguminous crops seems to be more suitable because of several advantages.

Leaf harvest

4-5 leaf harvests can be obtained every year from these trees. 2-3 harvests at an interval of 80-90 days during July to December and two during remaining 6 months is possible. After 4th year, average yield/tree is around 10-12 kg of which about 60% is during monsoon season and remaining 40% during summer. Leaf harvest must be done only by plucking individual leaves and not by shoot pruning (Fig. 8). Details of cultural operations, expenditure and leaf yield are given in Table-3 along with quantity of layings that can be brushed and cocoon yield.

Economics

During 1st year of planting, mulberry plants are allowed to grow and form sturdy stumps. During this period more income cannot be generated by way of leaf for silkworm rearing. One leaf harvest can be taken during May before pruning the plants. It is estimated that about 2000 kg in 5′ x 5′, 1000 kg in 5′ x 10′ and about 500 kg of leaf in 10′ x 10′ spacing can be obtained which will suffice to rear 200, 100 and 50 dfls respectively. The shoots obtained from each plant will serve as a best planting material and will fetch additional income. Expenditure during planting year is given in Table-1.

8. Fully grown tree of 6-7 years and leaf harvesting

Second, third and fourth year are mainly the growth period of plants when plants will be growing vigourously. Hence, it is advocated to take 4 leaf harvests only by individual leaf plucking as indicated in Table-2. Perusal of the table indicates that the average yield of 2nd, 3rd and 4th year would be around 10,825 kg, 5438 kg and 2716 kg in 5′ x 5′, 5′ x 10′ and 10′ x 10' spacing respectively and production cost per kg leaf is around 98 paise. At the rate of 1000 kg/100 dfls, 1080 dfls, 540 dfls and 270 dfls can be brushed in all the three spacings respectively which will yield sizeable income. Part of the expenditure incurred towards leaf harvest can be met by selling shoots for seed purpose. 5′ x 5′ spacing, about 2 tonnes of material per hectare can be obtained which would fetch around Rs. 1000/-.

Full potential of yield can be experienced only from 5th year and there will be 5-10% increase in leaf yield every year in wider plantation till 8th year. From 5th year onwards the yield difference in different spacings narrows down and when plantation reach 7-8 years, all the spacings give approximately equal leaf yield of 18-20 mt. It continues till 20-25 years without decline with constant income. In addition, large amount of shoots (8-10 tonnes) will be available every year which can be used for seed or as fuel. Expenditure, leaf yield, production cost, amount of layings which can be brushed and approximate cocoon yield are given in Table-4. Accordingly, 1700-2000 dfls can be reared every year with a minimum of four crops as indicated in Table-4 which will fetch an approximate gross income of Rs 4,000/ha/year and the net income can be calculated deducting the expenditure on silkworm rearing. In addition, 8-10 mt of shoots which are available will also fetch an additional income of Rs. 2,500-3,000/-.

It is sincerely hoped that this document will help those who are interested in growing mulberry as a tree. However, the expenditure shown on various items especially on labour will vary from place to place and with suitable modification this can be used as a guideline for implementation.

Table—1 : Expenditure on establishment of 1 ha mulberry plantation as high bush and dwarf tree.

Sl. No.	Labour and material reqd.	5′ x 5′ high bush		5′ x 10′ small tree		10′ x 10′ medium tree	
		Qty.	Cost	Qty.	Cost	Qty.	Cost
1	2	3	4	5	6	7	8
A.	**Labour**						
1.	Pit making 20/ manday, 4350, 2175 & 1090 pits	218	4360	109	2180	55	1100
2.	FYM appln. 400 pits/manday	11	220	5	100	3	60
3.	Lime appln. 600 pits/manday	7	140	4	80	2	40
4.	Planting 200/ manday	22	440	11	220	6	120
5.	Fencing	40	800	40	800	40	800
6.	Cultural operations	300	6000	200	4000	100	2000
7.	Leaf harvest 70 kg/ manday (shoot harvest)	30	600	15	300	8	160
8.	Total of A	628	12560	384	7680	214	4280

1	2	3	4	5	6	7	8
B.	**Material**						
9.	FYM (mt)	22	3300	11	1650	5.5	825
10.	Lime 500 g/pit & Rs. 500/mt	2.2	1100	1.1	550	0.55	255
11.	Saplings Rs. 0.25/ sapling	4500	1125	2250	563	1175	282
12.	Fencing material	—	200	—	200	—	200
13.	Fertilizer :						
	(i) NPK 25g/plant Rs. 1.92/kg	108	207	55	105	30	57
	(ii) Urea. 25g/plant Rs. 2.12/kg	108	229	55	116	30	63
14.	Total of B	—	6161	—	3383	—	1657
15.	Grand Total (8+14)	—	18821	—	11064	—	5937
16.	Leaf yield for one crop (Kg)	2175	—	1087	—	545	—

Table 2 : Maintenance cost, leaf yield and returns on 2nd, 3rd and 4th year of mulberry plantation.

Sl. No.	Labour and Material	5′ x 5′ high bush		5′ x 10′ small tree		10′ x 10′ medium tree	
		Qty.	Cost	Qty.	Cost	Qty.	Cost
1	2	3	4	5	6	7	8
	A. Labour						
1.	Pruning 100 Plants/manday	43.5	870	22	440	11	220
2.	FYM appln.	10	200	5	100	3	60
3.	Digging around plant (100 plants per manday)	43.5	870	22	440	11	220
4.	Fertilizer appln. 2 times	8	160	4	80	2	40
5.	Weeding around plant (200 plants per manday)	22	440	11	220	6	120
6.	Leaf harvest 50 kg/manday 0.75 kg I & II Crop 0.5 kg III & IV Crop	218	4360	109 173	2180 3460	55 88	1100 1760
7.	Total of A	345	6900				

1	2	3	4	5	6	7	8
B.	**Material**						
8.	FYM 5 kg/plant						
9.	Fertilizer :			11	1650	5.5	825
	Rs. 150/- mt	22	3300				
	(i) NPK complex 30g/plant						
	Rs. 1.92/kg	130	249	65	125	33	63
	(ii) Urea. 30g/ plant						
	Rs.12/kg	130	276	65	138	32.5	69
10.	Total of B	—	3825	—	1912	—	956
11.	Grand Total (7+10)	—	10725	—	5372	—	2716
C.	**Returns**						
12.	Total leaf yield (kg)	10875	—	5438	—	2720	—
13.	Cost of 1 kg (Rs.)	—	0.98	—	0.98	—	0.98
14.	Amount of dfls can be brushed @ 1000 kg/ 100 dfls	1080	—	540	—	270	—
15.	Cocoon yield 40 kg/100 dfls	432	—	216	—	108	—
16.	Returns @ Rs. 60/- per kg cocoon	—	25920	—	12960	—	6480

* For net returns, expenditure on rearing and cost shown in column 11 should be deducted.

Table 3 : Maintenance Leaf yield and expenditure of mulberry plantation from 5th year onwards.

Sl. No.	Labour and material	5′ x 5′ high bush		5′ x 10′ small tree		10′ x 10′ medium tree	
		Qty.	Cost	Qty.	Cost	Qty.	Cost
1	2	3	4	5	6	7	8
A.	**Labour**						
1.	Pruning twice a year @ 50, 40, 30 plants/manday	174	3480	108	2160	72	1440
2.	FYM application	10	200	10	200	8	160
3.	Digging around plant (50 plants per manday)	87	1740	44	880	22	440
4.	Fertilizer application twice a year	10	200	6	120	4	80
5.	Weeding around plants. 200/manday	22	440	11	220	6	120
6.	Leaf harvest-4 times; 50 kg/ manday	391.5	7830	326.5	6530	285.5	5712
7.	Total of A	694.5	13890	505.5	10110	320.5	7950
B.	**Material**						
8.	FYM (mt) @ 5, 10 & 15 kg/plant	22	3300	22	3300	16.5	2475

9. Fertilizer :						
(i) NPK Complex @ 75 g/plant Rs. 1.92/kg	217.5	418	130.5	251	81.75	157
(ii) Urea. @ 50, 60 & 75g/plant Rs. 2.12 per kg	217.5	461	130.5	277	81.75	173
10. Total of B	—	4179	—	3827	—	2805
11. Grand total (7+10)	—	18069	—	13937	—	10755
C. Returns						
12. Total leaf yield (Kg)	19575	—	16322	—	14270	—
13. Cost of 1 kg leaf (Rs.)	—	0.92	—	0.85	—	0.75
14. Amount of dfls can be brushed @ 1000 kg/100 dfls	1950	—	1630	—	1420	—
15. Amount of cocoon @ 40 kg/100 dfls	780	—	652	—	568	—
16*. Returns from cocoons @ Rs. 60/- per kg	—	46800	—	39120	—	34080

* For net returns, expenditure on rearing and cost shown in column 11 should be deducted.

Table 4 : Economics of high bush and small tree plantation from 5th year.

Sl. No.	Details	High bush 5′ x 5′	Small tree 5′ x 10′	Medium tree 10′ x 10′
1.	No. of plants/ha	4350	2170	1090
2.	Labour/year	694.5	505.5	320.5
3.	Labour wages (Rs.)	13890	10110	7950
4.	Material cost (Rs.)	4178	3827	2805
5.	Total cost (Rs.)	18069	13937	10755
6.	Harvestwise leaf yield & Dfls can be brushed @ 1000 kg/100 dfls			
	I harvest (Aug.)	6525/650	5437/540	4360/435
	II harvest (Oct.)	6525/650	5425/540	4360/435
	III harvest (Feb.)	4350/430	3255/320	3270/330
	IV harvest (May)	2175/220	2170/220	2180/220
7.	Total	19575/1950	16322/1630	14270/1420
8.	Cocoon yield @ 40 kg/100 dfls	780	652	568
*9.	Returns @ Rs. 60/- per kg cocoon	46800	39120	34080

In wider spacing of 5′ x 10′ and 10′ x 10′, there will be 5% and 10% increase in leaf yield respectively till 8th year. Accordingly, income will also increase. After 8th year in all spacings, 18000-20000 kg of leaf yield can be obtained and about 1800-2000 dfls can be brushed.

* For net income, rearing cost and cost shown in column 5 should be deducted from figures shown in column 9.

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