

Mulberry Cultivation In SOUTH INDIA

Dr. S. Krishnaswami



Central Silk Board

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I. INTRODUCTION

A major factor determining productivity and hence the profitability in Sericulture is the yield of mulberry crop. Maximisation of mulberry leaf yield per unit area will lead to the realisation of two most important objectives namely increased cocoon production per hectare and reduced cost of production. Therefore, it should be the primary aim of every sericulturist to ensure that he gets maximum leaf yield from his mulberry crop. It should also be realised that all measures taken to maximise leaf yield, simultaneously help to improve the quality of leaves which automatically secures an insurance against cocoon crop losses at the later stage of silkworm rearing.

Towards the above end, intensive agronomic research was carried out both at Central Sericultural Research Station, Berhampore and Central Sericultural Research and Training Institute, Mysore and based on the results achieved, the first paper on 'Package of Practices for mulberry cultivation' was presented at a seminar organised by the Central Sericultural Research and Training Institute, Mysore in November, 1972. These recommendations have been since popularised by the Institute at Mysore and the Departments of Sericulture in Karnataka, Tamil Nadu and Andhra Pradesh on a large scale. With the result a large number of sericulturists, particularly those raising mulberry under irrigation have been enabled to raise their mulberry yield from an average of 15,000 kgs. in the past to 30,000 kgs. and over per hectare currently.

While the recommendations of the Institute on mulberry cultivation have been no doubt helpful, it is being observed, however, that the significance of some of these practices have not been fully realised by the cultivators and hence, a revised paper is being published now, incorporating some new ideas and research findings and stressing the importance of these recommendations with due reasoning and explanations, so that their full significance could be appreciated and followed in full (without inadvertant lapses) by the sericulturists.

II. MULBERRY PLANT

Mulberry is a hardy plant capable of thriving under a variety of agro-climatic conditions. At the same time, it is also sensitive responding extremely well to optimum agricultural inputs but showing practically no growth when plant nutrients and mositure begin to operate as limiting factors. This is evident from the fact that under the poor

rainfall conditions of 25"-30" (625-750 mm) prevailing in South India, the current leaf yield is of the order of only 3,000-3,500 kgs. per hectare whereas under assured irrigation and appropriate fertiliser application, it can be stepped upto 30,000 kgs. or so, or nearly ten times. Further, mulberry under South Indian conditions, unlike in temperate regions like Japan, Korea and USSR, gives continuous growth almost throughout the year, because of optimum temperature conditions and good sunshine available. It is these aspects that should be properly appreciated and accordingly, every effort made to step up the leaf yield as indicated in this paper.

III. SOIL AND CLIMATIC CONDITIONS

Mulberry can grow practically on any type of land except on very steep lands. Good growths, however, are obtained when it is raised on either flat land or gently sloping or undulating lands. On more slopy or steep lands, necessary attention to proper soil conservation methods as contour drains, contour planting or even bench terracing should be given.

Mulberry grows in a wide range of soils, but best growth is obtained in loamy to clayey loam soils. The mulberry plant can tolerate slightly acidic conditions in the soil. In the case of too acidic soils with pH below 5, necessary corrective measures through application of Dolomite or Lime should be adopted. In the case of alkaline soils, application of Gypsum should be resorted to, for correction of the soil alkalinity.

Since mulberry is a deep rooted plant, the soil should be sufficiently deep upto about two feet in depth. In respect of elevation, mulberry thrives well upto about 4,000 feet, above which growth will be retarded because of the cooler temperature.

IV. ESTABLISHMENT OF THE MULBERRY GARDENS DURING THE FIRST YEAR

Mulberry falls under the category of perennial crops and once it is properly raised during the first year, it can come to full yielding capacity during the second year and last for over 15 years in the field without any significant deterioration in the yield of leaf. It is, therefore, very important that the initial planting and establishment of the crop is carried out according to scientific methods for obtaining best yield results in the subsequent years.

i) Land Preparation:

Land should be prepared by deeply ploughing with heavy mould board plough upto a depth of 12"-15" (30-35 c.m.) in order to loosen the soil before planting, taking advantage of the pre-monsoon showers during April-May. Thereafter, the land may be ploughed once or twice with a light plough or country plough to bring the soil to a fine

tilth. Afterwards, a basal dose of organic manure like compost or cattle manure should be applied at the rate of atleast 10 tonnes per hectare for rainfed mulberry and 20 tonnes per hectare for irrigated mulberry. Finally, the manure should be properly incorporated into the soil by ploughing and the land levelled and made ready for planting during the monsoon rains of June–July. It must be stressed here that application of basal dose of organic manure like compost or cattle manure is essential for successful initial establishment of the plantation. Under very exceptional circumstances, where these are not at all available, an alternative may be resorted to, by growing nursery raised plants and transplanting them into the main field.

Generally, pit system of planting with wider spacing should be adopted for rainfed mulberry while row system with closer spacing can be adopted for irrigated mulberry. Therefore, for planting mulberry under rainfed conditions, pits should be dug at a spacing of 3'×3' (0.9 m×0.9 m). The pits should be of the size 1¼'×1¼' (35 cm. × 35 cm.) and atleast 1¼' (35 cm.) deep. These pits are filled with soil, preferably mixed with some cattle manure and in the pits, the cuttings or rooted saplings are planted.

In the case of irrigated gardens, the prepared land is thrown into ridges and furrows (by using a ridge former or working with manual labour) as indicated in the diagram. The cuttings are later planted along the edge on the ridges as shown in Figure 1.

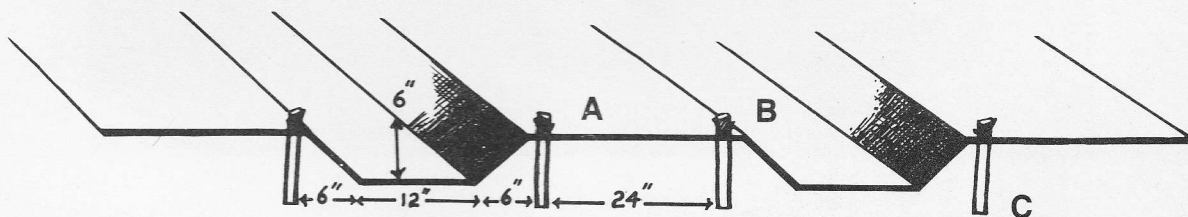


Figure 1 — Formation of Ridges and Furrows and Correct Way of Planting

A—Ridge B—Furrow C—Cutting

It may be noted here that there is only one irrigation channel for every two rows of mulberry plants. This helps in both saving and more effective use of the irrigation water.

ii) Planting Material and Planting:

In tropical conditions as in South India, mulberry can root easily and therefore, can be easily propagated through cuttings with minimum of time and expenditure. The cuttings should be prepared from 4–8 month's old hard wood branches which are brown

in colour and atleast $\frac{1}{2}$ " (10–12 mm.) in diameter. The cuttings should be atleast 7"–8" (18–20 cm.) long with a minimum of three buds (as shown in Figure 2). The ends of the cuttings should be clean cut with a sharp knife, without splits or bark peeling off.

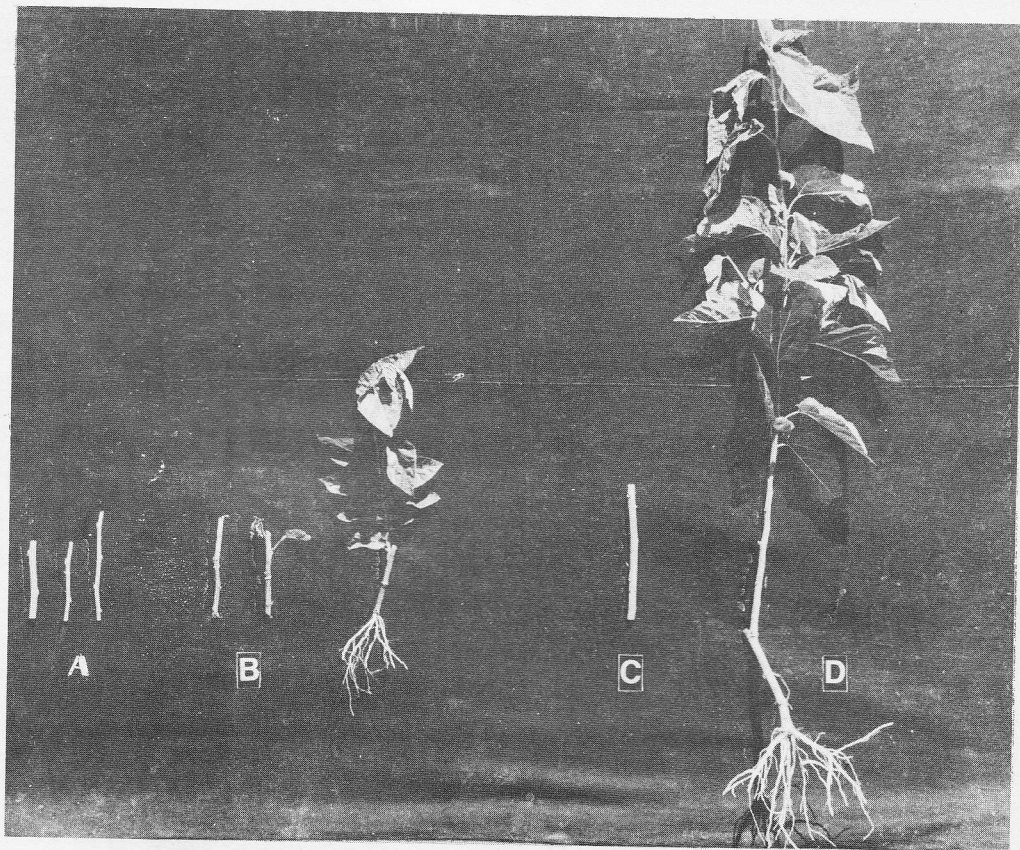


Figure 2— Selection of Cuttings and Their Response

- A. Short and thin cuttings are unsuitable for planting.
- B. Planting of unsuitable cuttings means no rooting (though sprouting) or very slow root formation and growth.
- C. Right type of cutting — $\frac{1}{2}$ " Diameter and 7"–8" in length.
- D. Root formation and growth vigorous when right type of cutting is planted.

It is in the selection of planting material that mistakes are often made which result in poor establishment of the plants with lots of failures and resultant gaps. Cuttings either thin in diameter or green in colour should be avoided as the chances of their success are poor. Therefore, for successful rooting of the cuttings every care should be taken to see that the cuttings of the desired maturity, thickness and length alone, as indicated above, are selected for planting. Because, only such cuttings provide necessary nutrients for the buds to sprout and grow till such time that adequate root formation takes place.

It is also to be remembered that the soil should be very fertile containing adequate quantities of organic matter. It is, therefore, absolutely necessary that whenever straight planting of cuttings is resorted to, the soil should receive a basal dose of manure like compost or organic manure at the rate indicated already. The manure should be thoroughly mixed with the soil before planting is undertaken.

At the time of planting, it is important to see that the cuttings are placed deep and the soil around well compacted, leaving just one inch alone of the cutting exposed. This ensures the cuttings being planted sufficiently deep in the soil resulting in the formation of roots below the ground level. Further, this will prevent the cuttings from drying up. While planting, the cuttings should be planted either upright or with only a very slight tilt.

In places where compost or cattle manure is not available, it is highly risky to resort to direct planting of cuttings. Under such conditions, it will be found necessary to raise rooted plants in nurseries and transplant $2\frac{1}{2}$ – 3 months old rooted plants with about 3' growth and a stem thickness of about 10 mm., in the main field. While transplanting nursery raised plants, it is important to see that the original cutting from which the plants have grown are buried deep in the soil atleast one to two inch below ground level and the soil around pressed hard as in the case of planting cuttings. This ensures better anchoring of the plant .

In all the new plantings with either cuttings or nursery raised plants, it should be so timed that there is 1–2 months of rainfall following the planting operation, particularly in the case of rainfed mulberry.

iii) Spacing:

In the case of rainfed mulberry gardens, the aim should be to raise mulberry plant with a sturdier frame so that it is able to withstand prevailing drought conditions better. Therefore, the spacing should be atleast 3'×3' (0.9 m. × 0.9 m.) as is being currently practised. When cuttings are planted in the pits prepared for the purpose, they should be planted in "threes" at a spacing of 6" (15 cm.) from each other, forming an equilateral triangle. When nursery raised rooted plants are transplanted, they may be planted as single plants.

In the case of irrigated mulberry, the overall advantage in raising mulberry for both quantitative and qualitative harvest is in favour of planting mulberry with a spacing of 2' (0.6 m.) between the rows and 9"–10" (23–25 cm.) within the row. This slightly wider spacing as compared to the existing Kolar system of row cultivation helps to produce better quality leaves from the point of view of silkworm rearing. In the case of irrigated gardens, where the practice of leaf picking instead of whole shoot harvest is followed, it would be found necessary to adopt a wide spacing namely 2'×2' (0.6 m. × 0.6 m.). Upto 3'×3' (0.9 m. × 0.9 m.) is also practised sometimes, but in this case the plants tend to become almost small trees and present problems of harvest.

iv) Variety of Mulberry:

An improved selection namely Kanva-2, also referred to as M5, is a superior variety evolved by the Institute, which is a vigorous strain responding well to manuring and capable of giving about 25% more leaf yield. This variety thrives well both under dry as well as irrigated conditions. Qualitywise also, it is superior to the local variety of mulberry and therefore, could be used with great advantage.

v) Manuring:

As pointed out earlier, application of a basal dose of organic manure like compost or cattle manure, is necessary for successful establishment of the garden. Thereafter, the young growing plants should be assisted to put forth vigorous and maximum growth through periodical fertiliser applications.

In the case of the rainfed garden, which is planted in June–July during the South–West monsoon season, the mulberry will receive sufficient rains from both the monsoons and this fact should be taken full advantage of to achieve maximum growth and build up a huge sturdy frame, so that the plant may stand the following drought months, from January to April very well. This is achieved by applying two doses of nitrogenous fertilisers such as Ammonium Sulphate or Urea at the rate of 25 kg. of N/ha for the first application after 2¹/₂ to 3 months of growth and again, another 40 kg. of N/ha as the second dose after an interval of another three months. This would enable the plants to reach a growth of about 6' (2 m.) in about 6 to 8 months' time.

In the case of irrigated mulberry, where the plant will grow vigorously due to assured irrigation, the first dose of nitrogenous fertiliser should be given after 2¹/₂ months of planting at the rate of about 40 kg. N/ha. In the next 2 to 2¹/₂ months, the plants would be ready for first harvest of leaves. Thereafter, the normal fertiliser application programme (described later) could be resorted to.

vi) Weeding and Inter-cultivation:

During the initial stages of plant establishment in the field, weed growth should be kept to the minimum, so that the growing young plants are not smothered by the weeds. Atleast two weedings should be carried out during the first six months after planting of cuttings, once after two months of planting and again after an interval of 2 to 3 months. The weeding operation should be thorough and the soil should be dug deep to remove the weeds with roots. This deep digging is carried out as a part of the weeding operation and results in necessary loosening of the soil and stimulation to the plants to grow vigorously. Thus, special care should be taken to reduce the weed growth as much as possible in the first year of planting. Thereafter, the shade effect of the fully grown mulberry will tend to keep the weeds down. Similarly, periodical

inter-cultivation should be resorted to, particularly in the case of dry mulberry gardens, during the first year so that soil loosening results in better aeration and stimulation of plant growth. This also helps in catching the rain water and its deep penetration for better retention of soil moisture.

V. MAINTENANCE OF THE MULBERRY GARDENS AFTER THE INITIAL ESTABLISHMENT

During the first year, all attention should be concentrated on establishing the mulberry field properly as indicated above. One should not be in a haste to take early leaf harvests before the plants attain full growth. In the case of mulberry under rainfed conditions, it will take ten to twelve months before first pruning is resorted to and systematic cultivation is taken up. On the other hand, in about six months time, the plants will reach full growth under the irrigated conditions and thereafter, systematic cultivation can be taken up. These are described below.

A. Rainfed Mulberry:

As mentioned earlier, mulberry planted in June–July will be ready for first pruning in June of the following year. Prior to that, two small harvests may be taken, once, some time in November–December and again in April–May. The harvests should be light and made by picking only mature leaves, leaving major part of the growing branch intact covered with leaves.

i) Pruning:

For maintaining mulberry in a state of vigorous growth and also for obtaining good quality leaves, periodic pruning is necessary. Pruning should also take into consideration the growth attained by the plants; normally the growth should be more than 6' (2 m.) in height and stem or branch girth not less than $\frac{3}{4}$ " (23 mm) at the bottom.

Rainfed mulberry should receive one annual bottom pruning in June coinciding with the receipt of the South–West monsoon rains. It is carried out by cutting the plants at a height of 3" to 4" (8–10 cm.) above the ground level with a sharp pruning knife or saw, in such a way that clean cuts are made without splitting the stem or branches, as shown in Figure 3. The system of "guddali" pruning currently practised is too drastic and cuts into the root zone which leads to reduced branching and gradually to even ultimate mortality of plants. Therefore, such a practice should be given up and pruning carried out as indicated above.



Figure 3 – Correct Way of Pruning 3"–4" Above Ground
with Clean Cuts at Cut Ends

ii) Weeding and Inter-cultivation:

Normally within a week of pruning, weeding and inter-cultivation should be carried out by ploughing or using a harrow. The weeds around the plants which are not generally removed by ploughing or harrowing are removed manually. This operation stimulates growth of plants and also assists in providing necessary tilth and deep penetration of rain water into the soil, resulting in better conservation and utilisation of the soil moisture. In all, upto four weeding and inter-cultivation operation should be carried out in June, October, January and April.

iii) Manuring:

The present low yields of leaf under rainfed mulberry is mainly due to poor rainfall and lack of or inadequate application of manures or fertilisers. Even under the limitations of scanty rainfall prevalent in South India, scope exists to improve leaf yields through optimum manuring of the fields. Therefore, manure should be applied in the form of both bulk organic manure like compost or cattle manure and chemical fertilisers.

Organic manure should be applied at the rate of ten tonnes per hectare, immediately after pruning and inter-cultivation and thoroughly incorporated in the soil. This should be carried out systematically once in a year so that the organic content in the soil is improved and as a result, the fertiliser application is more effectively utilised. Alternatively, where organic manure is not available, a green manure crop like *Sunhemp* can be raised annually during the rainy season and incorporated into the soil to serve the same purpose.

In addition to bulk organic manure, chemical fertilisers should also be applied at the rate 100 kg. N, 50 kg. P and 50 kg. K per hectare per annum, which may be applied in two equal split doses. The first dose should be applied sometime in late August, *i.e.* 6–8 weeks after the application of the organic manure and the second dose sometime in late November during the North-East monsoon rains. The first dose may be in the form of a complex manure like 15:15:15 or 17:17:17. About 300 kg. or 6 bags of 17:17:17 will be required to meet the requirements of the first dose of 50 kg. N, 50 kg. P and 50 kg. K. The second dose may be given as 50 kg. N only which is available in 250 kg. or 5 bags of Ammonium sulphate or about 100 kg. or 2 bags of Urea.

While applying the fertiliser, it should be spread close to the plant on either sides along the row, as shown in Figure 4. After application, the fertiliser should be incorporated well into the soil by digging with spade or forking in with a digging fork for good results as shown in Figure 5. This is very important operation, as otherwise, the fertiliser would be wasted and would not be effectively utilised by the plant.



Figure 4—
Fertiliser Application
on either side
of the Row

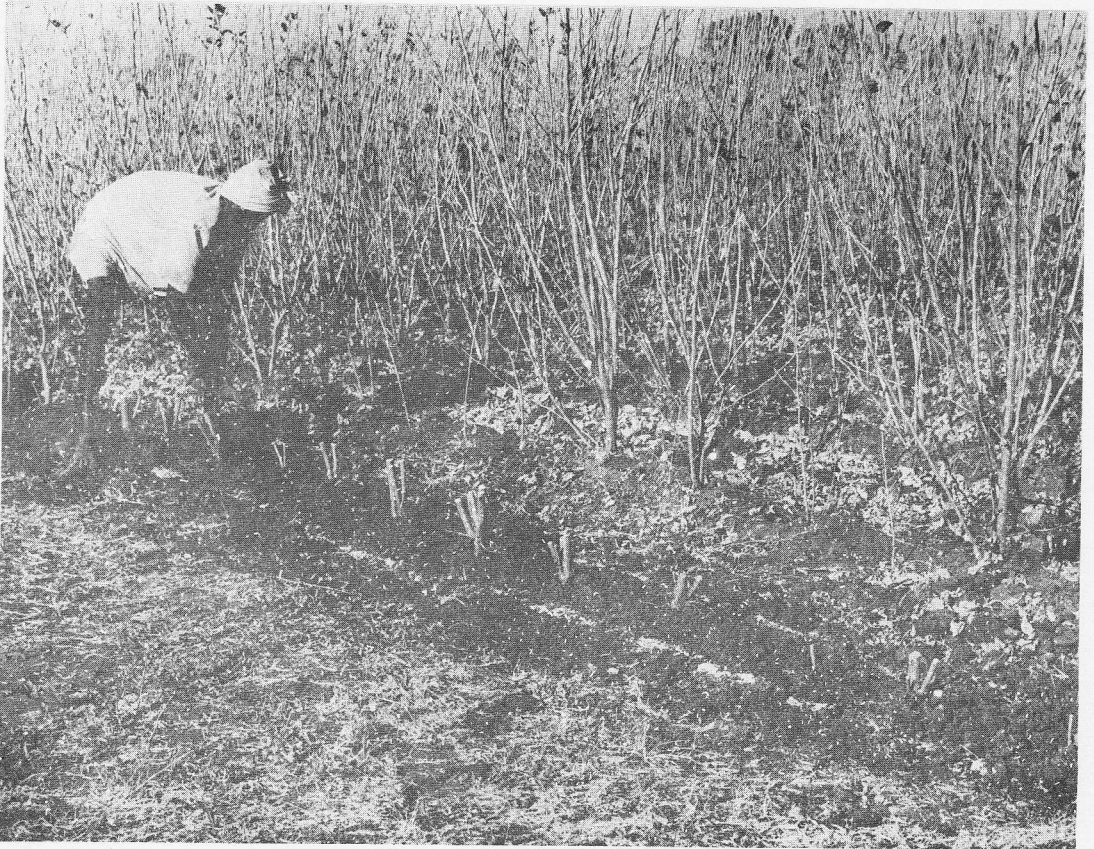


Figure-5 Incorporation of the Fertiliser into the Soil and working with the Spade

iv) Harvesting of Leaves:

Leaf harvest commences after about ten weeks from the time of pruning in June and upto six harvests can be taken during the year at an interval of roughly 7-8 weeks in between harvests. The quantum of harvest will depend on the precipitation received in the different seasons, being more during rainy season (more than $\frac{2}{3}$ of the total harvest) from August to December during the first three harvests and comparatively poorer during the drought months from January to May, except the "**Mungaru**" season when pre-monsoon showers are received resulting in a slightly improved harvest.

Picking of leaves should be carried out in time, that is to say, when the leaves are at the correct stage of maturity for harvest. Otherwise, part of the leaves will become overmature or coarse and suffer in quality from the point of view of nutritive value for the silkworms. Also part of the leaves may turn yellow, shed and be lost. Therefore, timely harvest as the leaves reach the required stage of maturity will lead to fuller harvest of the available leaves without wastage and realisation of maximum yield.

It is also important to stress here that while harvesting, the terminal buds of branches should not be picked but allowed to grow till the plant reaches its full frame of growth upto about 6' or so. Thereafter, the tips of the branches may be picked so as to encourage the formation of secondary branches. Unfortunately, the current practice is to strip the entire branch from top to bottom at every harvest which results in serious set back to the growing plant. This is also one of the main factors responsible for reduced harvests in the case of rainfed mulberry at present.

v) Leaf Yield:

By adopting the package of practices for the rainfed mulberry described above, it should be possible to harvest upto 7,000 to 8,000 kgs. of leaf per year per hectare which will mean more than 100 per cent improvement in yield over the present level of harvest which stands at about 3,000 to 3,500 kgs. per hectare per year.

The above schedules may be summarised as follows:—

Summary of Schedule of Operations for Rainfed Mulberry

Operations	Timings
1. Annual bottom pruning	With the commencement of South-West monsoon rains (Early June)
2. 1st weeding and inter-cultivation	Within a week after pruning (Mid June)
3. Application of bulk organic manure at 10 tonnes/hectare and incorporation of the same	Within a month of pruning (Early July)
4. 1st picking of leaves	About 2 ¹ / ₂ months after pruning (Mid August)
5. Application of first dose of fertiliser at 50 kg. N, 50 kg. P, and 50 kg. K per hectare <i>i.e.</i> 300 kg. or 6 bags of 17:17:17	6-8 weeks after application of organic manure and following first harvest of leaves (Late August)
6. 2nd weeding and inter-cultivation	5-6 weeks after the I picking of leaves (Early October)
7. 2nd picking of leaves	Two months after the I picking of leaves (Mid October)
8. Application of 2nd dose of fertiliser at 50 kg. N per hectare <i>i.e.</i> 5 bags of Ammonium sulphate or 2 bags of Urea	6 weeks after the II picking of leaves (Late November)
9. 3rd picking of leaves	Two months after the II picking of leaves (Mid December)

Operations	Timings
10. 3rd weeding and inter-cultivation	2-3 weeks after the III picking of leaves (Early January)
11. 4th picking of leaves	2 months after the III picking of leaves (Mid February)
12. 4th weeding and inter-cultivation	With receipt of pre-monsoon rains. 6-7 weeks after IV picking of leaves (Early April)
13. 5th picking of leaves	7-8 weeks after the IV picking of leaves (Early April)
14. 6th and final picking of leaves	7-8 weeks after the V picking of leaves (Late May-Early June)

B. Irrigated Mulberry:

Under irrigated conditions, mulberry registers faster growth than under rainfed conditions and therefore, the plant will attain sufficient growth up 6' (2 m.) in about 5-6 months' time and become due for first pruning or harvest. Thereafter, systematic cultivation can be commenced and leaf harvests taken at roughly about ten weeks interval, by resorting to bottom pruning in the case of row system of plantation and at about eight weeks interval where leaf picking method of leaf harvest is practised.

i) Pruning:

In the case of mulberry under row system with closer spacing, pruning is carried out at a height 1"-3" (2.5-7.5 cm.) above ground level by cutting the stem neatly with sharp pruning knives as described earlier. In all, five prunings combining five harvest of leaves with twigs are carried out during a year.

In the case of mulberry under pit system with wider spacing, pruning can be carried out twice during the year, once early in June and again in late November at a height of 3"-4" (8-10 cm.) above ground level, as in the case of rainfed mulberry, taking due care to see that clean cuts are made without splitting the branches.

ii) Weeding and Inter-cultivation:

This should be carried out invariably, immediately after the pruning operation so that weeds are eliminated completely from the mulberry plots and the soil is worked and loosened for necessary aeration and stimulation to the growth of the plants.

In the case of row system of planting, the inter-cultivation is carried out by deep digging of the soil upto 9" (22 cm.) depth including the space between the plants in the row. Simultaneously, the ridges and furrows also should be re-formed so that the furrows are sufficiently deepened to hold enough water during irrigation for necessary deep percolation to the root zone. Where feasible, power tiller or bullock power with mould board plough could be used for the purpose of weeding and inter-cultivation in order to save labour costs, but care should be taken to see that the implements do not cut or damage the roots of plants. Still, for working around the plants, resort to human labour will be found inevitable.

In the case of pit system of cultivation, the power tiller and bullock drawn ploughs may be used for weeding and inter-cultivation in the initial stage following the pruning but as the plants grow, this may not be feasible. Only manual working will meet the needs.

iii) Manuring:

Once in a year, bulk organic manure in the form of cattle manure or compost should be applied at the rate of 20 tonnes per hectare sometime during May-June prior to the onset of the monsoon rains and well incorporated into the soil. This may be carried out within one to two weeks following the pruning operation. Organic matter in the soil helps to utilise heavy applications of chemical fertilisers better and hence, the need for the organic manures. Thereafter, systematic application of chemical fertilisers should follow at periodical intervals coinciding with each leaf harvest.

The total annual requirement of plant nutrients is roughly about 300 kg. N, 120 kg. P and 120 kg. K per hectare. This should be applied in five split doses in the case of row system and six split doses in the case of pit system of cultivation coinciding with similar number of leaf harvests made, as indicated below:

Fertiliser Schedule for Irrigated Mulberry

	Row System	Pit System
1st Application	60 kg. N + 60 kg. P + 60 kg. K as complex fertiliser <i>i.e.</i> 7 bags of 17:17:17.	60 kg. N + 60 kg. P + 60 kg. K as complex fertiliser <i>i.e.</i> 7 bags of 17:17:17.
2nd Application	60 kg. N as straight fertiliser <i>i.e.</i> 6 bags of Ammonium sulphate or 2 ³ / ₄ bags of Urea.	40 kg. N as straight fertiliser <i>i.e.</i> 4 bags of Ammonium sulphate or 1 ³ / ₄ bags of Urea.
3rd Application	60 kg. N + 60 kg. P + 60 kg. K as complex fertiliser <i>i.e.</i> 7 bags of 17:17:17.	40 kg. N as straight fertiliser <i>i.e.</i> 4 bags of Ammonium sulphate or 1 ³ / ₄ bags of Urea.
4th Application	60 kg. N as straight fertiliser <i>i.e.</i> 6 bags of Ammonium sulphate or 2 ³ / ₄ bags of Urea.	60 kg. N + 60 kg. P + 60 kg. K as complex fertiliser <i>i.e.</i> 7 bags of 17:17:17.

	Row System	Pit System
5th Application	60 kg. N as straight fertiliser <i>i.e.</i> 6 bags of Ammonium sulphate or 2 ³ / ₄ bags of Urea.	40 kg. N as straight fertiliser <i>i.e.</i> 4 bags of Ammonium sulphate or 1 ³ / ₄ bags of Urea.
6th Application	—	40 kg. N as straight fertiliser <i>i.e.</i> 4 bags of Ammonium sulphate or 1 ³ / ₄ bags of Urea.
Total	300 kg. N + 120 kg. P + 120 kg. K	280 kg. N + 120 kg. P + 120 kg. K.

Application of fertilisers should be carried out within three to four weeks following pruning operation in the case of row system. In the case of pit system, however, the first application following the pruning is given within three to four weeks of pruning and thereafter, subsequent applications are given within two to three weeks of every leaf harvest.

The fertilisers should be applied with due care by spreading evenly on either sides of the plants along the row and completely incorporated into the soil by digging in or forking in for effective utilisation by the plants. Otherwise, they will run the risk of getting decomposed in hot sun or leached out in heavy rains.

iv) Irrigation:

Among various agronomic inputs to which mulberry plant responds very well, irrigation ranks high as it enables full utilisation of very heavy applications of fertiliser for crop production. Since this item of input is fairly expensive, judicious use of water for maximising production is very important.

Under South Indian conditions, particularly in Karnataka, the sericultural tracts receive fairly distributed rains from May to November amounting to 25–30" and all that needs to be done for helping the plant growth is to supplement the rains with the required irrigations which may be 5 to 6 in number. During the dry period from December to April, however, systematic irrigation should be given regularly at roughly about a week to ten days' interval, depending upon the soil condition and its water holding capacity. In light sandy loam soils more frequent irrigation at a week's interval may be found necessary while in heavy clayey loam soils, irrigation at 10 to 14 days interval may be found adequate.

It is also important to remember that at the above intervals of irrigation, adequate quantities of water should be supplied as irrigation at a time. It has been estimated that 1¹/₂ to 2 acre inches of water is required per irrigation and therefore, this quantity should be supplied without fail. It is being observed that sericulturists have a tendency to water their gardens lightly but too frequently, quite often at every three or four days

interval. For getting best results from irrigation, copious irrigation upto $1\frac{1}{2}$ to 2 acre inches should be given at a time, so that water fills the channels completely and percolates deep, and does not get depleted from the root zone easily, due to evaporation. If necessary, whenever the irrigation channels get silted up, they should be scooped and deepened at periodical intervals for ensuring optimum level of irrigation (as shown in Figure 6).

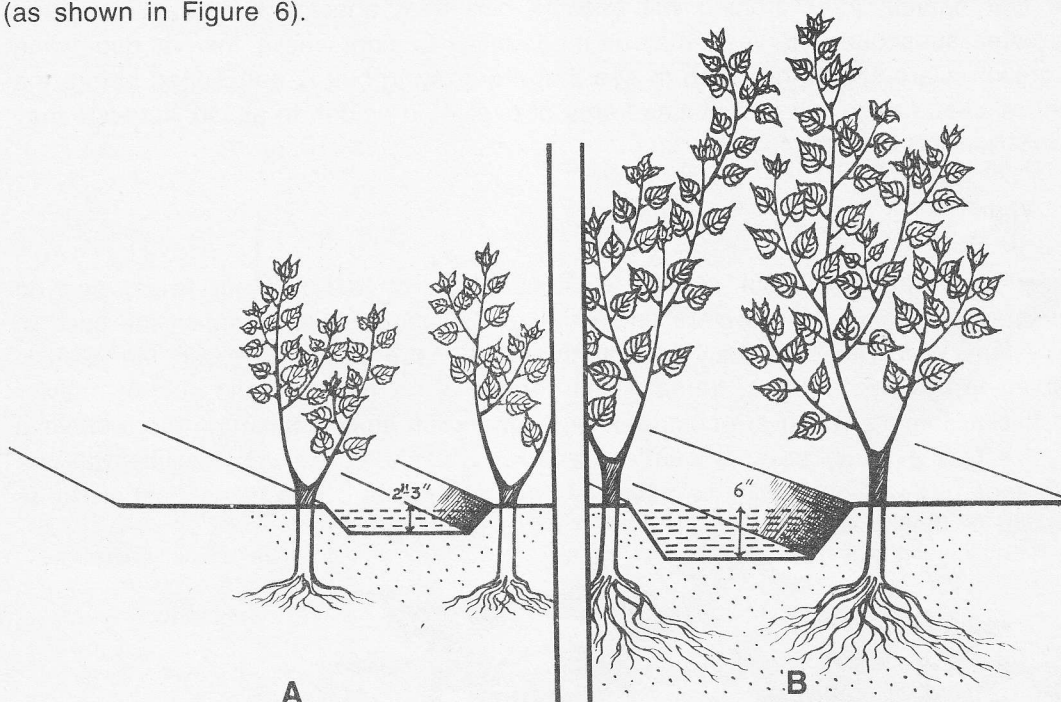


Figure 6 — Correct Way of Irrigation

A. Shallow channel and superficial Irrigation

B. Proper size channel and deep Irrigation

Thus, when irrigation is regulated as indicated above, best growth of mulberry is obtained and water is also effectively utilised without any wastage.

v) Leaf Harvest:

In the case of row system of cultivation, leaf harvests are taken by the shoot cutting method, where in the twigs alongwith the leaves are cut at the bottom, as in pruning. In fact, in this system both the pruning and harvesting operations are combined which leads to considerable saving of labour. In all, five harvests are possible, at an interval of roughly $2\frac{1}{2}$ months or 10 weeks during the year. Growth, however, may be delayed or hastened depending on the seasonal temperature conditions—being slower in cold winter months and faster during hot summer months. Accordingly, harvesting also should be adjusted by advancing or delaying by a week or so. What is particularly important to observe is that plant growth is adequate before it is harvested. As per the

recommendations made in this paper, particularly of manuring and irrigation, the growth of 4½ to 5 ft. height will be easily achieved in about ten weeks time and the plants will be ready for harvest.

Harvesting in the case of pit system is carried out by picking leaves individually. The first harvest after pruning will become due after about 2½ months time and thereafter, subsequent harvests may be made at six to eight weeks interval depending on growth. Care should be taken to see that the growing bud is not clipped before the plant reaches full growth and attains frame of over 6' in height. In all, six harvests may be taken in this system of cultivation.

vi) Yield:

An average of about 25,000 to 30,000 kgs. of leaf (without twigs) can be harvested per annum per hectare under the row system of cultivation. In the case of pit system, however, since only two prunings are made during the year, the plant is enabled to develop a higher frame which permits of six harvests and also of heavier and thicker leaves, which are comparatively superior in quality, although the total yield may be of the same order as under the row system of cultivation. However, the advantage of improved quality of leaves is more than offset by the heavy cost of labour involved in leaf picking (Figure 7).



Figure 7 — Proper Irrigation and Manuring Ensure Improved Yield

The above schedule may be summarised as follows:—

Summary of Schedule of Operations for Irrigated Mulberry

A. ROW SYSTEM

Operations	Timings
1. 1st pruning combining harvest	With the commencement of South–West monsoon rains (Early June)
2. 1st weeding and inter-cultivation	Within a week after pruning (2nd week of June)
3. Application of bulk organic manure at the rate of 20 tonnes per hectare and incorporation of the same	Within a fortnight after pruning (Mid June)
4. 1st dose of fertiliser application	Within a month after pruning (Early July)
5. 1st harvest of leaves	By pruning (Mid August)
6. 2nd weeding and inter-cultivation	Within a week of last harvest (2nd week of August)
7. 2nd dose of fertiliser application	Within a month of last harvest (Mid September)
8. 2nd harvest of leaves	By pruning (Early November)
9. 3rd weeding and inter-cultivation	Within a week of last harvest (2nd week of November)
10. 3rd dose of fertiliser application	Within a month of last harvest (Early December)
11. 3rd harvest of leaves	By pruning (Mid January)
12. 4th weeding and inter-cultivation	Within a week of last harvest (3rd week of January)
13. 4th dose of fertiliser application	Within a month of last harvest (Mid February)
14. 4th harvest of leaves	By pruning (Late March)
15. 5th weeding and inter-cultivation	Within a week of last harvest (1st week of April)
16. 5th dose of fertiliser application	Within a month of last harvest (Late April)
17. 5th harvest of leaves	By pruning (Early June)

B. PIT SYSTEM

Operations	Timings
1. 1st Bottom Pruning	With the commencement of the South–West monsoon rains (Early June)
2. 1st weeding and inter-cultivation	Within a week after pruning (2nd week of June)
3. Application of bulk organic manure at the rate of 20 tonnes per hectare and incorporation of the same	Within a fortnight after pruning (3rd week of June)
4. 1st dose of fertiliser application	Within a month after pruning (Early July)
5. 1st harvest of leaves	By leaf picking (Mid August)
6. 2nd weeding and inter-cultivation	Within a week of last harvest (3rd week of August)
7. 2nd dose of fertiliser application	Within three weeks of last harvest (2nd week of September)
8. 2nd harvest of leaves	By leaf picking (Early October)
9. 3rd dose of fertiliser application	Within three weeks of last harvest (4th week of October)
10. 3rd harvest of leaves	By leaf picking (Late November)
11. 2nd Bottom Pruning	Immediately after 3rd leaf harvest (Late November)
12. 3rd weeding and inter-cultivation	Within a week after 2nd pruning (1st week of December)
13. 4th dose of fertiliser application	Within a month after 2nd pruning (3rd week of December)
14. 4th harvest of leaves	By leaf picking (Early February)
15. 5th dose of fertiliser application	Within 3 weeks after last harvest (4th week of February)
16. 5th harvest of leaves	By leaf picking (1st week of April)
17. 4th weeding and inter-cultivation	Within a week after last harvest (2nd week of April)
18. 6th dose of fertiliser application	Within 3 weeks after last harvest (Late April)
19. 6th harvest of leaves	By leaf picking (Late May)

VI. QUALITY OF LEAF HARVEST

Finally, a word about the quality. The aim of mulberry cultivation for silkworm rearing should be not only increased leaf yields, but also of quality leaves. Therefore, the leaves in the field at the time of harvest should be full grown, lush looking and dark green in colour. Such quality harvests are readily achieved by following the package of recommendations made in this paper. Paling or yellowing of leaves are symptoms of deficiencies in plant nutrients or moisture availability, which should be promptly corrected.

Generally harvest under the row system of cultivation comprises of leaves growing on the primary shoots which are vigorous in growth and thin because of the close spacing. As a result, the leaves are also comparatively thinner and tend to dry faster when severed from the plant. This disadvantage is overcome by the method of twig harvest and twig feeding, or cutting the twigs alongwith leaves into larger bits and then feeding. Again, since the leaves grow faster on thinner branches, they have a tendency to get over-matured and turn yellow in comparatively shorter period. Further, during the rainy seasons, they contain comparatively more moisture and therefore, build up too much humidity in rearing beds, leading to outbreak of diseases, particularly, Grasserie and Muscardine. Therefore, greater care should be paid to ensure better ventilation of rearing rooms; harvesting leaves only when they are fully mature; avoiding overfeeding in rearing beds; satisfactory drying of beds in between feeds and if necessary to feed the worms with more mature leaves, *i.e.* with the normal second-age leaves to first-age larvae, third-age leaves to second-age larvae and so on.

As pointed out earlier, in the case of irrigated mulberry under the pit system, the leaves are comparatively thicker and heavier, and contain comparatively less moisture during rainy seasons. Hence, their feed value in the rearing bed is better and lasts longer.

From the point of view of preserving the quality of leaves, harvest should be made invariably in the morning or evening during the cooler hours of the day. Further, they should be carried during transit properly covered with wet cloth or gunny, in bags or baskets. Otherwise, the harvested leaf will suffer in quality due to drying and loss of moisture, particularly during summer.

Another important point to be kept in view is that in the case of irrigated gardens, one proper irrigation should be given invariably, when the worms under rearing pass the fourth and final moult, so that succulent leaves are available for the last instar worms.



