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Original Article**Adoption of Mechanization in Sericulture****Murali, S¹ and Manthira Moorthy, S.²**¹Scientist - C, P2 Basic Seed Farm, NSSO, CSB, Horsley Hills, Andhra Pradesh - 517325,²Director, National Silkworm Seed Organization, CSB, Bengaluru - 560068*Corresponding author: dr.mmrl@rediffmail.com

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INTRODUCTION

Many technological advances have taken place in mulberry sericulture over last two decades. The productive varieties of mulberry, high yielding races of silkworms, cost effective methods of silkworm rearing and effective pest and disease management have made sericulture more lucrative and popular among farmers. But, yet have to do a lot towards reducing production cost of silk cocoons. The imported silk which is not only superior in quality than Indian silk is available at lesser prices. Hence, efforts are required to reduce cost of production of Indian silk besides improvement in the quality to encounter menace of imported silk. Major share towards the cost of production of silk goes for labour required for cultivation of mulberry and rearing of silkworms. The labour costs are around 60 to 70 *per cent* of production cost of silk. Under these circumstances mechanization can prove as a critical and decisive input for reducing the production cost. Apart from it, mechanization also helps to reduce drudgery, obtaining timeliness, getting through work, improvement in working environment and better life to farming community. It has been observed that mechanization has helped in many countries to check exodus of young rural population and bring more area under cultivation.

There is good scope for improving productivity of workers through adoption of tools and machines for carrying out various operations in sericulture which mainly includes mulberry cultivation and silkworm rearing.

Why Mechanization?

To reduce the cost of production of silk, we must improve labour productivity. The labour output efficiency in Indian sericulture is very low compared to advanced countries like Japan and China. The main reason for this is high degree of mechanization and availability of efficient machines for almost all kinds of the activities. In Japan efficient machines are available and used for operations like land preparation, plantation, intercultural operations, harvesting of leaves and shoots, fertilizer and pesticide application, disinfection, leaf chopping, chawki rearing, late age rearing, separation of

matured worms, cocoon harvesting, deflossing etc. But, in India most of the sericultural activities are still being performed manually or with tools and equipments which are not only inefficient but also obsolete. Sericulture is a unique enterprise where crops are harvested 5 - 6 times a year by repeated pruning and training of mulberry. As a result of this, calendar of operations/activities from pruning of garden to harvest of cocoons has to take place within 60-70 days, hence making it a time oriented practice in the large holdings ensuring timeliness of all activities may not be possible by the manual operations. The activities which have to be completed in shortest time are pruning of a mulberry garden, weeding and cultural operations, harvesting of leaf /shoot, application of bed disinfectants, picking matured larvae for spinning and cocoon harvest. The availability of large number of workers for a short time is a problem. To overcome the labour problem, we must improve the output and productivity of the workers. This can be achieved through appropriate mechanization at different stages of mulberry cultivation and cocoon production through adoption of appropriate tools and machines by the sericulturists.

Purpose of Mechanization in Sericulture:

- Increasing the productivity of land and labour.
- Timeliness in various mulberry cultivation and silkworm rearing activities
- Getting more thorough works in various cocoon production activities.
- Reducing drudgery in many activities.
- Cutting down cost of production of silk cocoons.
- Improving the quality of silk cocoons.

Mechanization In Mulberry Cultivation

Mulberry cultivation is highly labour intensive. It is estimated that for the maintenance of one hectare mulberry garden around 800 man-days are required per year. Hence there is good potential for reduction in labour requirement through mechanization. The overall labour requirement could be reduced to 1/10th through mechanization. Mechanization will, therefore, result in significant reduction in cost of production of mulberry leaves, obtaining timeliness in various operations, improvement in quality of leaf and drudgery alleviation. The following activities in mulberry cultivation can be fully or partially mechanized:

Land Preparation for Mulberry Plantation:

Mulberry is a perennial crop. Once planted, it lasts for 15-20 years. Therefore, the land for mulberry should be thoroughly prepared before plantation. Land for new mulberry plantations can be prepared faster and at lesser cost by using tractor operated mould board or disk plough, cultivators and harrows. It is estimated preparation of land involving ploughing/cultivation, harrowing, pit making, trench making requires a total of 435 mandays/ha whereas by using tractor and tractor operated digger/trencher the mandays requirement can be drastically reduced to 75.

Mulberry cutting preparation machine:

Mulberry is propagated through cuttings. A worker manually prepares 1,500 to 2,000 cuttings in a day. With the help of mulberry cutting preparation machine developed by CSR&TI, Mysore 1,400 to 1,500 cuttings can be prepared in one hour. It is also estimated that preparation

of cuttings required for one hectare needs 8 mandays whereas through cutting machine 1 manday is sufficient.

Mulberry Plantations and Intercultural Operations:

The V-1 variety evolved by CSRTI, Mysore has revolutionized the mulberry production in southern India, with a yield of over 60 MT/ha/year of high quality nutritive mulberry leaves under irrigated conditions. To exploit the full potential of this variety and make effective utilization of inputs like water and manures and mechanized cultivation in order to expand the garden size to enable a farmer to go for large scale rearing, a new plantation method named "paired row" was developed by CSR&TI, Mysore. Here mulberry plants are placed in rows at 90 cm apart. A pair of rows is distanced from another pair of row by 150 cm. The mulberry plants in each row are spaced at 60 cm. In brief it is called (5' + 3') x 2' paired row plantation. Now the mechanized cultivation of V-1 has enabled farmers to go for establishing mulberry garden even up to 10 acres and above.

Power tillers, power weeders and tractor operated cultivators could be used for intercultural operations in mulberry gardens. It is estimated that by using men & bullock cart more than 100 mandays are required per hectare mulberry garden for the intercultural operations, however through tractor and power tiller the operation consumes less than 10 mandays/ha. The mechanized cultivation reduces cost of intercultural operations by 40 to 50% thus reducing cost of leaf production by 30 to 35% and finally the cost of cocoon production by 20 to 25%.

Application of Manures and Fertilizers:

Manures and fertilizers application in mulberry about 8 mandays/ha are required, whereas by using fertilizer applicator the work can be efficiently completed with 1 manday/ha.

Irrigation:

For irrigating a mulberry garden, 8 mandays/ha are required, whereas by using drip or sprinkler, it can be drastically reduced to 2 mandays/ha.

Mechanized spraying of chemicals in mulberry gardens:

Timely control of diseases and pests is very much required for production of healthy mulberry leaves. Farmers can spray chemicals uniformly in less time with the help of self-propelled CSR&TI sprayer, TNAU power tiller mounted sprayer and ASPEE tractor mounted sprayer.

Leaf/Shoot harvesting:

For shoot harvesting in a hectare of mulberry garden about 50 mandays are required per hectare whereas a shoot harvester reduces the consumption of mandays to just 5 mandays/ha.

Pruning:

One hectare mulberry garden pruning requires about 60 mandays, but by utilizing a pruning machine (power operated) nearly 50 *per cent* of labour can be saved. Also, by using power tiller operated pruner, the requirement of mandays can be still reduced to 10 mandays/ha.

(B) Mechanization in Silkworm Rearing

Silkworm rearing is highly labour intensive. About 40 per cent of rearing expenditure accounts for labour wages for cleaning and disinfection of rearing house, chopping mulberry leaves for young age silkworms, feeding shoots to late age silkworms, silkworm picking and mounting, cocoon harvesting, cocoon deflossing and sorting of cocoons.

Rearing House disinfection:

It is very important that the rearing houses must be thoroughly disinfected to ensure good cocoon crop. About a decade ago, farmers were using hand operated gator sprayers which were suited for disinfection in dwelling houses or small rearing houses due to low delivery pressure. But now to conduct disinfection in modern and separate rearing houses which have at least 4-5 m high roof and length ranging from 15 to 60 m or more, power sprayers should be used. Power sprayers are very effective and fast for disinfection of rearing houses and rearing equipments. They facilitate the farmers to deliver the disinfection chemical at high pressure at all places in the rearing house, thus maintaining high level of cleanliness and hygienic conditions for silkworm rearing. Both electricity and engine operated sprayers have gained popularity among farmers due to effectiveness and fastness in carrying out disinfection process. Further, an LPG flame gun designed and developed by CSR&TI, Mysore is also becoming popular among sericulturists because it is both time and cost effective tool for disinfection of rearing houses, rearing stands and mountages.

Leaf Chopping for Young Age Silkworms:

Silkworms in their chawki stage are fed with chopped tender mulberry leaf. The leaves are chopped manually which is feasible for small scale rearing. But, for commercial CRC's some mechanical aid is required to cut the leaves in lesser time. CSR&TI leaf chopper can cut 250-300 kg of mulberry leaves per hour into different sizes for different age silkworms, whereas a man can chop only 8 Kg/hour. Hence, leaf chopping machine is very useful for Chawki Rearing Centres (CRC) where large scale young age rearing is undertaken. It costs about Rs.25, 000 as against imported Japanese machines worth few lakhs of rupees.

Silkworm Separator:

Silkworm separating machine can separate 100 dfls (40,000-45,000) silkworms per hour from mulberry shoots. But, a man can do this job @25 dfls/h. Besides, the use of this machine will avoid spinning of cocoons in the rearing beds, ensure full crop harvest, reduce the cost of manual picking of silkworms from beds and delay in mounting silkworms.

Advantages of silkworm separating machine:

- Fast separation of the silkworms.
- This avoids spinning of the cocoons in the bed.
- Almost 100 *per cent* silkworms are separated through this machine and thus no loss of cocoons, hence more yield
- Less cost for picking silkworms
- Beneficial to big rearers as machine facilitates quick picking of the silkworms.

- The dependency on workers can be reduced and a farmers himself with his family members can separate the silkworms from rearing bed and mount them for cocooning

Deflossing of the cocoons:

The reelable layer of the cocoons is covered by a soft and loose silky material called floss. It is essential to remove the floss from cocoons to find end of the filament. The floss also obstructs the free flow of cocoons in sorting and reeling machines. The process of removing floss from cocoons is called as deflossing or peeling of cocoons. Small rearers can use hand operated deflossers whereas for medium and large farmers, motorized deflossers are available. The deflossers help in deflossing the cocoons at a very fast rate and save labour charges. The deflossers also clean the cocoons. The deflossed cocoons fetch higher price in market than those which are not deflossed. A deflossing machine can remove floss of about 500 Kgs/day whereas, manually only 10 Kgs can be deflossed per day.

Tray washing Machine:

In sericulture plastic trays are used for young age rearing, storage of cocoons and egg production. Before using, they must be washed thoroughly and disinfected. As per present practices, first the plastic trays are dipped in bleaching powder solution stored in a tank for some time and then cleaned and washed manually. This operation takes lot of time and causes delay. In a commercial CRC's, a large number of plastic trays are to be washed at frequent intervals. To facilitate washing and disinfection of plastic trays, CSRTI, Mysore developed a Tray washer. It comprises of a chemical storage tank, a pump, perforated pipes for spray of pressurized chemical solution on trays and nylon brushes for rubbing the tray sides and surfaces. This machine can clean about 100-125 trays/hr.

Cocoon Harvester:

For harvesting the cocoons spin on rotary mountages can be harvested using cocoon harvester. In one day it can harvest cocoons obtained from 200 dfls whereas manually cocoons from only about 25 dfls can be harvested.

Collapsible Mountage Pressing Tool:

To facilitate quick and proper folding and pressing of the plastic collapsible mountages, CSRTI, Mysore has developed a simple Collapsible mountage pressing tool. It helps in fast bundling of the plastic collapsible mountages.

Index of Mechanization in Mulberry Garden and Silkworm Rearing:

| Sl. No. | Parameters | Mandays utilization (Manually) | Mandays utilization (Machines) |
|---------|--|--------------------------------|--------------------------------|
| | Mulberry Garden | | |
| 1 | Land preparation for mulberry cultivation (ha) | 435 | 75 |
| 2 | Mulberry Cutting/day | 1500-2000/day | 1400-1500 /hr |
| 3 | Preparation of Cuttings/ha | 8 | 1 |

| | | | |
|---|---|---------|---------------|
| 4 | Intercultural Operations/ha | 100 | <10 |
| 5 | Application of Manures & Fertilizers/ha | 8 | 1 |
| 6 | Irrigation/ha | 8 | 2 |
| 7 | Shoot Harvesting/ha | 50 | 5 |
| 8 | Pruning/ha | 60 | 10 |
| | Silkworm Rearing | | |
| 1 | Leaf Chopping Machine/hr | 8 Kg | 250-300 Kg |
| 2 | Silkworm Separator/hr | 25 dfls | 100 dfls |
| 3 | Deflossing Machine/day | 10 Kg | 500 Kg |
| 4 | Tray Washing Machine/hr | | 100-125 trays |
| 5 | Cocoon Harvester/day | 25 dfls | 200 dfls |

CONCLUSION

Mechanization in sericulture involves the use of farm tools, equipments and machineries for preparation of land for mulberry cultivation, maintenance of plants through training and pruning, harvesting of leaves, proper storage of leaves, equipments of disinfection and silkworm rearing appliances. In India, 65-70 per cent cost of the cocoon accounts for labour wages involved in various sectors. Therefore, there is a need to reduce the labour dependency to reduce the cost of cocoon production.

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