



## **MOUNTING AND SPINNING**

**Process of ripening of worms:** Towards the end of the fifth stage, the silkworm stops eating and becomes the so-called mature larva and starts spinning the cocoon. Properly reared worms, when ripe, will try to spin good cocoons even under unsuitable conditions; but it must be remembered that the object of the worm in spinning the cocoon is to protect itself from external disturbances and natural enemies during the most critical period of its metamorphosis and not to help the rearer by yielding easily reelable cocoons etc. The rearer can get this reward for his labour only; if he cooperates with the worm by making the conditions such that, by spinning a commercially good cocoon it also most efficiently protects itself. This cooperation consists in providing the ripe silkworm with suitable mountages to facilitate its spinning of good cocoons.

The eating period during the fifth stage may last for five to seven days in the case of multivoltine and bivoltine races in the tropical areas and seven to nine days in the case of bivoltine and univoltine races in sub-tropical areas. The mature worm is readily distinguishable by its translucent colour. The body also shrinks in length; there is also a visible constriction at the 4th and 5th segments. The worm loses appetite and begins to look about as though in search of a suitable place to which to attach itself. Generally, the ripening worms move towards the periphery of the rearing trays in search of anchorage to commence spinning of cocoons. This is the time for picking the ripe worms and putting them on mountages. This process is called 'mounting'. It must be remembered that all the worms in a tray do not ripen simultaneously. It usually happens that, by the time the majority of worms in a tray are ripe, some of the early worms will be over-ripe. These will have lost a quantity of silk by the time they are picked up, and they are moreover in such a hurry to spin their cocoons that they proceed to do it anyhow, without waiting to select a proper place, and thus produce irregular shaped and flattened or sticky cocoons causing loss to the rearer. If the worms are mounted before they are fully ripe, they will move about and sometimes falloff, and also they defecate in the cocoonage, often soiling and lowering the value of the cocoons which other worms are spinning. The cocoons spun by worms which are mounted too early will be smaller and inferior. It is, therefore, of great importance that the rearer should be ready with the required number of mountages well in time and also mount the worms when they are fully mature. This is also the time when the rearer should not hesitate to hire enough number of persons to pick up the ripe worms and mount them. Any negligence at this stage is bound to cost the rearer heavily.

**Process of Spinning:** As the mature worms are mounted on the mountages they pass out the last excreta in semi-solid condition. During rains when the humidity is high, excess body moisture is also eliminated as liquid urine at the time of mounting. After defecation, the worm starts spinning the cocoon. It anchors itself first to the mountage by oozing a tiny droplet of the silk fluid which immediately hardens and sticks to the mountage. Then by swinging the anterior part of the body continuously, the silkworm draws out the silk fluid from the two silk glands which lie on either side of the body of it. Silk fluid is excreted in minute quantities and hardens to form the long continuous silk filament. At first, however, the worm spins a loose hammock which provides it with necessary foothold to start spinning of the cocoon proper. The filament is spun in the shape of  or  and the former type is common in the outer layers of cocoon shells while the latter type is usual in the middle and inner layers. In this way layers after layers of filament are laid to form the compact shell of the Cocoon.

The hammock though formed of a continuous filament forms a labyrinth of highly tangled network and this constitutes the floss of the cocoons which is not reelable. Quantity of floss is comparatively less in uni and bivoltine varieties of silkworms and is about two per cent of the weight of cocoons. In the case of multivoltine races, however, it is high and may amount to as much as ten per cent or even more.

After the compact shell of the cocoon is formed, the shrinking larva finally wraps itself in a gossamer layer and detaches itself from the shell to transform into the pupa or chrysalis. This last layer is only a body sheath of the worm and does not form part of the main shell and as such is not reelable just like the floss layer.

The process of spinning the cocoon by the worms takes about 1 to 2 days in the case of multivoltines and 2 to 3 days in the case of uni/bivoltine worms. It is necessary to keep the silkworm larvae undisturbed during this period, because shaking during cocoon spinning causes suspension of spinning and even breaking of the thread. It is also very necessary to provide good ventilation, as the worms have to get rid of a good deal of moisture in the process of spinning; the silk, though it is solid, is still wet, and needs to dry to set into a firm cocoon.

**Mounting of worms:** Collecting mature silkworms and mounting is a laborious job which requires a great deal of labour. Normal practice is to hand picking the mature worms by skilled labour who can identify the ripe worms. The ripe worms are collected in hand trays and later put on the mountages. As mentioned earlier, "chandrike" is the most popular type of mountage in Karnataka and West Bengal. As this entire process is carried out with manual labour it is possible to ensure uniform distribution of

mature worms on the mountages and thus reduce the incidence of double cocoons. In this method it is also possible to eliminate the diseased larvae and thus achieve a fair measure of uniformity of cocoons.

In order to save labour involved in picking mature worms, some simple techniques have been evolved involving the use of green branches or nets. In the "branch method", branches with green leaves are placed over the rearing bed and when the worms crawl into them they are taken out and shaken off over a mat to dislodge the worms which are later collected and put on the mountages. Similarly, in the case of "net method" also, a net is spread on the bed after feeding and the mature worms which do not feed any more will come up and crawl on to the net which are taken out and shaken off the net over a mat and mounted as in the case of branch method.

In shoot rearing method, larvae maturing early which constitute 10 to 20 per cent of the total larvae can be picked by hand as they ripen. Later on when the remaining larvae mature uniformly and almost simultaneously, these can be collected by shaking off the larvae from the upper layers of mulberry branches to mats. They are then mounted on the mounting frames.



**Methods of free mounting:** In this process no hand picking of ripe worms is involved. The mountages, which in the case are made of straw, are placed directly over the trays containing the ripening worms. The mature worms crawl on to the mountages and commence spinning of cocoons. In the Soviet Union, dried weeds are placed on the trays of ripening worms as mountages. While these methods are no doubt economical, uniform distribution of spinning worms cannot be achieved and this is to be deemed as a disadvantage.

In Japan, where straw cocoonages are popular, the general practice is to spread a layer of cut straw over the rearing bed. The ripe worms crawl through the layer of cut straw to the mountages. The mountages with the worms in the process of spinning are later on transferred to trays covered with sheets of newspaper which absorb the urine and fecal matter excreted by larvae.

Revolving mountages, made of cardboard are also in use in Japan and they facilitate the free mounting of ripe worms directly from the trays. The revolving mountages should be removed from

the tray when a very thin layer of the cocoon shell has been formed and should be kept suspended, undisturbed for the worms to complete the formation of the cocoons.

**Population density in mounting:** A good rearing can to a great extent be spoiled by bad mounting. In India, it is very common to find that the rearer perforce resorts to over crowding of silk worms on mountages, leading to such undesirable results like double cocoon. This is indeed a sad waste of silk. This is by no means the worst result of over-crowding. The worms soil and stain the cocoons of other worms with their excreta; and as in a crowded cocoonage, deficiency of ventilation will hinder rapid driving of the moisture: damp, stained and inferior cocoons will be the result.

The proper density of mounting in the case of chandrike could be taken as 50 worms for a space 30 cm x 30 cm i.e. roughly one sq. foot or about 2 sq. cm for each worm. On this basis a chandrike of standard size of 1.8 m x 1.2 m could be used for mounting about 1,000 to 1,100 larvae. In the case of revolving mountage the number of cubicles in each mountage will be 13 x 12 or 156. Ten such cocoonages are combined to make a revolving frame. It will, therefore, be evident that the mounting capacity of a revolving frame will be 1560 or about 50 per cent more than a standard chandrike. As each worm gets a cubicle to spin a cocoon, a revolving mountage is to be deemed as an ideal cocoon age.

**Care during spinning:** The worms require attention during spinning of cocoons as the quality of cocoons is to a great extent determined by the environmental conditions that obtain when the worms are on the mountages. It may, in general, be stated that dry weather is good for spinning.

Generally, worms during spinning require a slightly higher temperature than during rearing; but too high a temperature is to be avoided as it will compel the worms to spin in haste and thus waste a lot of silk. The worms which are in too great a hurry to spin waste a good deals of silk in the preliminary processes and spin irregularly shaped cocoons of poor reeling quality. This is especially the case with over-ripe worms, of which there are always a certain number. Too low a temperature on the other hand, causes delay in the spinning and injuriously affects the colour and lustre of the cocoons and their texture. The cocoons spun in a low temperature will not be so compact as those spun in a higher temperature. The delay occurs not only before the larva commences spinning, but the process of spinning itself takes longer duration.

The effect of too high a temperature on the filament is to make it thicker than the normal size, and of too low a temperature, to make it thinner. If there is violent fluctuation of temperature during the process of spinning, it leads to ununiformity of the filament spun and a flaccid cocoon results which is a source of serious trouble in the cocoon reeling- leading to wastage of silk. Abnormally high

or low temperatures affect the health of the worms and make the resultant cocoons unfit for seed purposes. A temperature around 24°C is to be deemed quite ideal for spinning.

Humidity plays an equally important role in determining the quality of cocoons spun. It would be ideal if the relative humidity could be maintained in the range of 60 to 70 per cent. Too much moisture in the air has a directly injurious effect on the quality of the cocoons and affects the lustre of the filament. From the point of view of reeling, drier the air during mounting the better it will be, but too great a dryness debilitates the worms and is to be avoided. Ventilation is an essential point for attention as a good deal of moisture has to be got rid of and there is also a good deal of excreta-solid, liquid and gaseous. Insufficient ventilation will spoil the health of the worms and the quality cocoons, and produce the worst effects of dampness. While there should be free ventilation at the time of spinning/it is however to be remembered that the spinning worms should not be exposed to violent draughts. The practice in Karnataka and West Bengal to place the chandrikes in the open has much in its favor. It is however necessary in this case not only to avoid draughts of wind but also direct sunlight which distorts the spinning process by the worms.

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## HARVESTING

It was already explained earlier that the cocoon is a protective casing of silk filaments which the silkworm spins around itself to enable it to go through the delicate processes of metamorphosis undisturbed by the external phenomena. After completion of spinning of cocoon, the larval skin is cast off and pupation takes place. This generally occurs on the 3rd or 4th day of spinning in the case of multivoltines and 4th or 5th day of spinning in bivoltines and univoltines in the temperate regions. The pupa when formed has a thin cuticular skin which is soft to touch and may get ruptured easily, if disturbed. The stained cocoons, one frequently sees in Karnataka and West Bengal are due to very early harvest of cocoons from the mountages and the consequent damage to the pupa leading to the blood soaking through the cocoon shell. This stain sometimes soaks through the whole of the cocoon shell rendering the stained portions unreelable. Besides, at the stage when pupation has just commenced, the vital functions are very vigorous and even the slightest damage to the pupae during harvest or subsequent transportation leads to fermentation with disastrous effects on the reeling quality of the cocoons. Too much delay in harvest is also not desirable, as it reduces the time available for transportation of cocoons to the market, subsequent stifling of cocoons etc., with a possible danger of moths emerging. Additionally there is the loss in weight of cocoons due to driage and the consequent erosion of monetary returns to the cocoon grower. It is, therefore, desirable that the cocoons are harvested on 5th day in Karnataka and West Bengal type of climates and on 6th or 7th day in Jammu & Kashmir region. By this time, the pupa begins to turn brown and becomes firm and less liable to injury during harvest, transport etc. If the cocoons are intended for seed, it would be preferable to wait till the pupae assume a darker colour and begin to be active. This means that the harvest should be on 6th day in tropical regions and 7th or 8th day in temperate zones. Harvesting of cocoons is normally done by hand. Only in the case of revolving mountages simple devices are used to separate the cocoons from the cubicles. The frames containing the cocoons are pressed against a wooden board which carries pegs corresponding to the cubicles in the revolving cocoonage. The harvesting process is the best time for sorting cocoons according to the quality *I* as good cocoons are easily distinguishable from double and defective or damaged cocoons. The general practice of our farmers to remove cocoons from the mountages *en masse* and try to market them as such, needlessly increases the scope for damaging the reeling quality of cocoons as the stained cocoons invariably affect the neighboring ones. The cocoons should be sorted out into good cocoons, double cocoons, pierced cocoons and stained cocoons. This greatly improves the marketability of cocoons.

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