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DRUDGERY REDUCTION IN TROPICAL TASAR SILKWORM *ANTHRAEA MYLITTA D.* SEED PRODUCTION

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ABSTRACT

Antheraea mylitta Drury (Lepidoptera : Saturniidae) is a commercially exploited vanya silkworm that is raised outdoors on host plants such as Asan and Arjun. Because tasar seed production includes rearing of silkworms for quality seed cocoons production to process them for Disease Free Layings (DFLs) production, it allows for mechanization at several stages of the process, including rearing and plantation management. The various drudgery reducing equipment's used presently are brush cutter, centrifuge, chain saw, cocoon transportation baskets, egg drying machine, electric sprayer, ladder, lime duster, microscopes, secateurs etc. The use of brush cutter for weeding, electric sprayer for spraying, chain saw for pollarding and lime duster for dusting significantly reduces the person days requirement. Further, the egg dryer helps in quick drying of DFLs than in conventional method. Thereby, the mechanization is helping in increased efficiency of different activities in tasar seed production sector apart from drudgery reduction. The future interventions required in the seed production process are tasar cocoon sorter, tasar seed cocoon garlander, garlanding thread maker, degarlander, moth catcher, grainage house disinfection, disease scanner, pierced tasar cocoon grader etc.

Keywords : Drudgery, Machine, Mechanisation, Person days, Tasar, Vanya.

Introduction

India is the only country to produce all five types of silk, namely mulberry, eri, muga, tropical tasar and temperate tasar (Selvaraj *et al.*, 2020). The cultivation of tropical tasar silkworm host plants, raising of silkworms for production of raw silk, preparation of disease-free layings (seed) and reeling of cocoons for further processing of raw silk for weaving are all included in tropical tasar sericulture. (Vishaka *et al.*, 2021A). Tropical tasar seed production is a part of tasar silk production (Nadaf *et al.*, 2022) where tasar seed are of immense biological and economic importance. The tasar seed production demands quality seed cocoons and their scientific processing so as to ensure disease freeness and improved production. The tasar seed cocoons are produced by the rearing of tasar silkworm *Antheraea mylitta* D. in the field while thus produced seed cocoons are processed in the grainages for seed production. The produced seed are supplied to different agencies for further multiplication so that at the end commercial seed reared to harvest reelable cocoons. During the process of rearing and grainage, different activities are carried out. These activities demand labour. The labour involved in tasar sericulture is dominated by women workforce (Vishaka *et al.*, 2021B). Therefore, labour saving technologies or tools or mechanisation can relieve the workers from time constraints and drudgery involved in tasar sericulture.

Mechanisation in sericulture

Compared to tasar sericulture, more number of drudgery reducing equipments are available in mulberry sericulture. The tractor operated mouldboard or disk plough, cultivators and harrows for new mulberry plantation land preparation, mulberry cutting preparation machine for propagation, power tillers, power weeders and tractor operated cultivators for intercultural operations, power tiller mounted and tractor mounted sprayers for spraying of chemicals, flame gun for rearing house disinfection, leaf chopping machine for chopping tender mulberry leaves, silkworm separator for separating mulberry silkworm from shoots, deflossers for deflossing and cleaning mulberry cocoons, tray washing machine to wash plastic trays in mulberry chawki rearing centres, collapsible moutage pressing tool etc are being used in mulberry sericulture (Chanotra and Bali, 2019). Unlike mulberry silkworm rearing which takes place indoor, the tasar silkworms are reared outdoor under open field conditions. Though mulberry sericulture is practiced in most of the states of India and other countries, tropical tasar sericulture is predominant in the tribal regions of India. As a result, it necessitates extra attention.

Activities in tasar seed production

The hatched tasar larvae from tasar seed are brushed on the tasar host plants. The fate of larvae and their transformation into pupae with protective covering cocoon

which is reeled or spun for raw silk production are largely dependent on choice or rearing field, host plants, brushing time, supervision and maintenance of larval population and other rearing operations. The formed cocoons are collected from branches of tasar host plants and marketed as either seed or commercial cocoon. The activities during different stages of tasar seed production demanding person days (PD) are as follows.

Establishment of new plantation: Land preparation, cleaning, levelling (20 PD/acre); Cultural operations (10 PD/acre/operation); Pot irrigation (2 PD/acre/operation); Fertiliser application (1 PD/acre/operation); Pit digging (1 PD/day/30 pit) etc.

Maintenance of existing plantation: Pollarding (4 PD/acre); Cultural operations (10 PD/acre/operation); Fertiliser application (2 PD/acre) etc.

Tasar silkworm rearing: Brushing, transfer of larvae, disinfection of field, supervision etc. Since tasar larvae are reared two (bivoltine) to three (trivoltine) times in a year, rearing period increases gradually from first to third crop, it demands person days of 50, 60 and 70 during first, second and third rearing crops, respectively.

Tasar Grainage: Cocoons harvesting (1 PD/20 trees); Making of garlands (1 PD/5000 cocoons); Emergence, pairing, depairing and oviposition of moths (3 PD/10000 cocoons); Moth crushing and smear preparation (1 PD/500 smears); Moth examination (1 PD/300 smears); Washing, disinfection and drying of eggs (1 PD/10000 DFLs); Packing

of DFLs in cloth bag/labelling (1 PD/20000 DFLs); Transportation of DFLs etc. All these activities are to be carried out during each grainage crop. There are two to three grainage crops/year.

Considering the above requirement of human force, the drudgery reducing machines/tools/equipments/implements in tasar sericulture could help in timeliness of activities, cutting down cost of DFLs production, improved and quality seed production besides increasing productivity of land and labour.

Tools utilised in tasar seed production

Though much emphasis has been given on mechanisation after tasar seed cocoon production for reeling, twisting, weaving etc so as to produce silk yarn but it is interesting to note that productivity of rawsilk could be enhanced by accentuating mechanisation in pre-tasar cocoon sector. The reeling cum twisting machine, hand operated wet reeling machine, motorised tasar reeling machine, motorised cum pedal operated spinning machine, solar operated spinning machine, unnathi reeling machine, kamadhenu improved vertical reeling cum spinning machine, buniyad reeling machine, two step reeling cum twisting machine, sonalika reeling machine, re-reeling machine, charkha reeling machine, permeation cooking chambers, two pan cooking device, stainless steel cocoon cooking vessel etc are being exploited in the post tasar cocoon activities while the pre tasar cocoon activities are reposed with few tools as follows (CTRITI 2022).

Tool	Use	Advantage
Brush cutter	Cut grasses and weeds	Quicker and less tedious
Chain saw	Pruning and pollarding	Ensure new growth of leaves
Cocoon transportation basket	Carry cocoons to grainages	Cocoons accommodated comfortably
Egg drying machine	Dry washed tasar seed	Quicker drying
Egg transportation basket	Carry seed to farmers	Prevent mechanical injury
Egg washing cum disinfectant machine	Clean and disinfect seed	Quick, easier and effective disinfection
Flame gun	Disinfection of field and grainages	Speedy and no harmful residue
Ladder	To reach higher parts of plants	Easy access
Microscope & centrifuge	Pathogen identification	Disease free seed production
Nylon net (chawki rearing)	Rearing young larvae	Protection from rain, wind, predators
Nylon net (coupling)	Enhance coupling	Reuse of mated males
Secateurs	Cut small branches	Tree not adversely affected
Power duster	Dusting disinfectants	Large area covered in less time
Power sprayer	Spray disinfectants	Large area covered in less time

Exploitable tools for tasar seed production

Following are some of the tools employed in agriculture and may be exploited in tasar seed production for drudgery reduction (Anonymous 2021; Anonymous 2022).

Tool	Feature	Tasar activity
Scythe	Durable metal material; best handle grip; stand and cut down grass without having to bend.	Cut weeds/grass in field
Lopper	Scissors used for pruning twigs and small branches; like secateurs with very long handles; easy to use; light weight; long-lasting.	Cut small branches with tasar cocoon
Telescopic Tree Lopper	Safe tree care from the ground without ladder; telescopic powerful cut of branches up to a height of five meters. options : High-speed (thin branches) and high-power (thicker branches); adjustable cutting head; light weight	Cut ground inaccessible branches with cocoons
Sticky Trap	Available in colour Yellow / Blue / White; glue does not dry out; traps lasts until the surface area is completely covered with insects; weatherproof (effective in rain)	To trap flying insects in grainages
Solar Insect Light Trap	Attracts & kills the adult Insects by trapping in water pot; light Weight; easy installation; operates on solar system; work for 4 hours after sunset with auto On /Off; effective area: one Ha.	Insect pest management in tasar fields/chawki gardens
Rat and Rodent Repellent Device	Effective against rats, mice & squirrels only; not affect pets like cats, dogs, fish, or birds; very less consumption of electricity; ultrasonic plug & play device; safe for human; Repels upto 2500 Sq. feet area	In grainages where their menace is common (Nadaf <i>et al.</i> , 2021A)

Heavy Duty Long Reach Pole Pruner	Long-reach pole pruner for pruning, trimming and cutting high branches; anti-vibration; cut branches at a height of up to five meters; petrol operated	Pruning ground inaccessible branches
Light Weight Petrol Chainsaw	Tough compact saw; highly suitable for general tree maintenance; light weight; petrol operated	Pollarding
Petrol Earth Auger Machine	Used for digging holes in the soil; petrol operated	Pits for plantation, erecting poles and collection of soil samples
Backpack Petrol Leaf Blower	Leaves, grass cuttings and field debris moved easily with the powerful air stream; petrol operated	Grainage floor cleaning/Sweeping / field cleaning after pruning
Bird Scare Tape	Birds are confused and deterred by flashing and shimmering holographic, iridescent ribbon; can stand up to wind, rain and sun; eco-friendly and harmless	For third instar outdoor rearing / in field where birds are frequent
Monkeys and Birds Repellent	Sound produced protects plantation upto 2-3 Acres; eco-friendly; not harm any birds or animals	Tasar silkworm rearing
Agricultural Spray Drone	Control Mode includes both manual and autonomous; hovers for 15 to 20 minutes depending on payloads; speed of 10 m/sec; height of 10 m above ground level; spray tank volume of 10 lit with 4 nozzles	Fertiliser/insecticide spray

		
Scythe	Lopper	Telescopic Tree Lopper
		
Sticky Trap	Solar Insect Light Trap	Rat and Rodent Repellent Device
		
Heavy Duty Long Reach Pole Pruner	Light Weight Petrol Chainsaw	Petrol Earth Auger Machine
		
Backpack Petrol Leaf Blower	Monkeys and Birds Repellent	Agricultural Spray Drone

Figure: Exploitable tools for tasar seed production (Anonymous 2021; Anonymous 2022).

Upgrading of tools utilised in tasar seed production

Among the different tools being utilised in tasar industry, some of the considerable upgrading in them are as follows.

Tool	Possible side effect	Likely remedy/upgrading
Chawki nylon net	Increased humidity due to rain	Easy detachable sides of net lined with interlocking tapes for easy allowing ventilation and/or growing natural dehumidifier plants in chawki plot
Cocoon Transportation basket	Jerky movement of pupae	Inner lining of basket with washable foam padding
Egg drying machine	Continuous air flow to specific surface of seed	Slow action for seed upside down movement
Microscope	Eye strain on focusing spores	Display on screen
Oviposition cups	To be handled frequently	Holder for large number of cups to move from one place to other

Requirement of innovative tools for tasar seed production

The some of the innovative tools specific to tasar seed production required (Nadaf *et al.*, 2021B) are as follows.

Tasar cocoon sorter: In the process of choosing seed cocoons, factors including living pupa, heavy cocoon weight, shell weight, and cocoons that aren't filmy, dead or infested are taken into consideration. The current human selection of seed cocoons may be avoided by an auto sorting machine based on these criteria.

Tasar seed cocoon garlander and degarlander: The quality seed cocoons are being garlanded for the preservation till adult emergence (Nadaf *et al.*, 2019). Upon the emergence, these cocoons are to be degarlanded as they become pierced cocoons. This whole process demands human resources. Hence, a tool which could automate these tasks aid in reducing manpower.

Moth catcher: Adults sometimes tumble to the ground upon emerging in the early morning, when it is typically difficult to observe them and as a result may not be in a position to mate. In order to get more DFLs from fewer cocoons, it is necessary to design a mechanical device that catch and prevents tumbling.

Grainage house disinfection: Every day, waste is generated on the grainage floor during seed production. Hence, a wiper that collects all trash in one direction and subsequently disposes of it professionally aids in maintaining hygiene while also reducing drudgery.

Disease scanner: An instrument in the form of a scanner which could contribute details of pebrine and other disease causing agents in tasar silkworm and its different stages will bring radical increase in silk production.

Pierced tasar cocoon grader: The seed cocoons yield pierced cocoons after their use in seed production. Their disposal is currently based on different qualities which entails correspondingly different prices. The sorting machines of such pierced cocoons which are produced in many lakh each year lessen worker involvement.

Future thrust

When it comes to addressing equity distribution from urban rich to rural poor, sericulture in India has shown to be a perfect career for the rural populace, especially the weaker segments of society (Vishaka *et al.*, 2019) which needs special attention. Hence the future thrust areas for drudgery reduction in tasar seed production includes the following.

- Emphasis on pre tasar cocoon mechanisation
- Systematic study on tasar farmers requirement of novel and/or upgrading of tools
- Development of tasar sericultural machinery chart for different activities
- Custom hiring centers for tasar farmers

The emphasis on the above thrust areas helps in reduced dependence on labour which is scarce, local youth be attracted to operate machine which create livelihood for them and timeliness of activities with increased efficiency of labour may be ensured.

Conclusion

Tasar silk has tremendous demand. This is expected to have increased call for tasar seed. Though seed production activities are in place utilising the labour and presently available tools but the emphasis on pre tasar cocoon drudgery reduction including utilisation of tools of agriculture, upgrading of presently utilising tools and systematic research and development would enhance the productivity of labour and tasar raw silk.

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