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Research Article

ANALYSIS OF ECONOMIC VIABILITY OF COMMERCIAL MULBERRY SAPLINGS REGENERATION USING CONVENTIONAL STEM PROPAGATION METHOD

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ABSTRACT

The economics of stem cutting propagation in mulberry provides a profound insight into the cost-effectiveness and financial benefits of this method compared to other propagation techniques. Stem cutting propagation are widely recognized for its efficiency which involves taking cuttings from a mature mulberry plant and rooting them to produce new plants. This method is particularly advantageous due to its lower initial costs and simplicity compared to alternatives like tissue culture or seed propagation. Economically, stem cutting eliminates the need for expensive seeds and reduces the risk associated with seedling variability thereby leading to more consistent crop quality and yield. The initial capital investment is relatively modest and covering primarily labour and materials for the cuttings and rooting environment. Furthermore, the reduced time frame for producing mature plants accelerates the return on investment thereby providing a quicker pathway to profitability. Analyzing the cost components including labour, equipment and consumables, reveals that while there are ongoing expenses such as maintenance and care of the cuttings these are often outweighed by the savings and benefits derived from a successful propagation cycle. Stem cutting propagation also offers scalability thereby allowing for the expansion of mulberry cultivation with minimal additional costs. The method's ultimate economic advantage lies in its capacity to deliver high-quality, uniform plants at a lower cost, enhancing the overall productivity of mulberry farms. Additionally, examining case studies and regional data highlights variations in economic outcomes based on local conditions, such as soil quality, climate and market access. The ultimate success and profitability of stem cutting propagation are influenced by these factors which can either amplify or mitigate the method’s inherent advantages. In regions where conditions are optimal, the benefits of stem cutting propagation are maximized thereby leading to substantial economic gains.

Keywords: Benefit- cost ratio, Economics, Stem Cuttings, Mulberry, Viability.

INTRODUCTION

In sericulture, the domesticated mulberry silkworm, *Bombyx mori* L., is raised indoors and mostly feeds on mulberries (*Morus* sp.). The genus *Morus* sp. has about 70 species and majority of which are found only in Asia (Kumar *et al.*, 2022). As a member of the Moraceae family, mulberries are identified by the presence of idioblasts in the upper epidermis of their leaves. Mulberries can be grown in a variety of climates including tropical and temperate zones (Yang *et al.*, 2018). While 24 to 28°C and 65 to 85% were the best temperature and humidity ranges for mulberry growth respectively. Mulberry requires an average of 50 to

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60 mm of rainfall once every ten days and is well established in a region with an annual rainfall range of 700 to 2300 mm (Bharathi *et al.,* 2023).

Mulberries can tolerate a maximum temperature of 38 °C but they cannot survive below 13 °C. Sunlight has an impact on photosynthesis which is directly related to plant growth (Saini *et al.,* 2023). Commercial mulberry cultivation can occur at elevations of 300 to 800 meters above mean sea level with an ideal range of 600 meters (Vijayan *et al.,* 2018). Mulberries grow best on soils that are sandy, clay-based or red loamy in texture. Mulberries do best in a pH range of 6.2 to 6.7, which is very acidic. Through mulberry agriculture, the four southern states of India -Karnataka, Tamil Nadu, Telangana and Andhra Pradesh were engaged in the commercial breeding of silkworms (Datta, 2000). Mulberries (*Morus* sp.) can reproduce sexually as well as vegetatively.

Mulberry seeds have limited viability and high heterozygosity (Sudhakar *et al.,* 2018).Among the disadvantages of the cutting strategy include increasing homogeneity, prolonged nursery gestation period, lack of shoots with a diameter of 10–12 mm and increased nursery area needs (Vijayan *et al.,* 2021). Lack of seed and increased labour-intensiveness in preparation, uprooting, maintenance and transportation are the key constraints on the stem cutting approach of propagation (Sudhakar *et al.,* 2018). Stem cuttings are a common method of propagation for mulberries (Ozturk *et al.,* 2023). Lateral buds on stem cuttings will trigger shoot growth if an apical bud is lacking by speeding up cell proliferation there (Vijay and Susikaran *et al.,* 2023).

Mulberry semi-hardwood cuttings have been grown in three different growing conditions (partial shade, green shade and poly-house) over the months of July, August and September (Bharathi *et al.,* 2022). When cuttings are placed in a poly-house in August where propagation traits including leaf count, survival rate and sprouting per cent are readily obvious (Bharathi *et al.,* 2024). Semi-hardwood mulberry cuttings depend heavily on the growth medium and surrounding conditions for success (Singh *et al.,* 2018).

MATERIALS AND METHODS

In the years 2021–2022, the research was conducted in the Department of Sericulture and Clonal Complex at the Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam. Stem cuttings from commercial mulberry cultivars V1 and MR2 were obtained from the main field at the Department of Sericulture, FC&RI, TNAU, Mettupalayam, and were incorporated into the research.

Stem cutting propagation

Using this method, well-grown 8–10 month-old plants with a shoot diameter of 8–10 mm and at least 4–5 active, 15–20 cm-long lateral sprouts were trimmed off without breaking them. The cutting's base was submerged in an Azospirillum solution (one kilogram in forty liters of water) for twenty minutes in order to induce roots early. With a 45° tilt and a spacing of 15 cm by 7 cm, the plant without splitted basal cambium was planted in an elevated nursery bed measuring 4 by 1.5 meters with slant cut at base (Bharathi *et al.,* 2023). After four to five days, give the nursery one watering. While preparing for mulberry sapling generation, 1600 kilograms of farm yard manure (FYM) were applied to 800 square meters of nursery space (Singh *et al.,* 2018).One hundred grams of VAM were given for every square meter. After hand weeding for 60–70 days following planting, 100 g of urea per square meter was provided. The main field was ready for the 90–120 days saplings to be planted. The economics of propagating stem cuttings are computed using an 80% survival probability (Bharathi *et al.,* 2022).

Economics

Through the use of traditional stem cutting technology, the saplings were mass produced. The economics was computed with the same assumption.

Fixed cost

Expenses that stay the same for a predetermined amount of time are known as fixed costs. Rent, buildings and other structures etc., are examples of fixed costs.

Variable cost

Expenses may differ considerably with time and directly proportional to the volume or work donein a business is known as variable costs. Labour costs and other expenses related to running a firm are considered variable costs. Compared to fixed expenses, variable costs are more difficult to monitor and control.

Gross income

Gross income is the total amount of money received from all sources, less any expenses.

Net income

Net income denotes all profit that organization or business rounded off after deducting all the expenses.

Net profit margin

Net profit margin is one of the most important indicator of business financial health.

B: C ratio

Benefit cost ratio is used to know the investment in a work or project for their profitability or viability as devised by Kothari *et al.* (2006).

$$\text{B: C ratio} = |\,\text{PV (Benefit)}\,| \,/\, |\,\text{PV (cost)}\,|.$$

BCR < 1, Investment in loss

BCR = 1, Investment neither loss nor profitable

BCR > 1, Investment is profitable

Payback period

Payback period is used to determine period required for a business to recover an investment made in a project (Murthy *et al.*, 2009).

$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Cash flow per year}}$$

RESULTS AND DISCUSSION

Mulberry cuttings are raised year-round in nurseries with the best care and circumstances possible. The anticipated costs and profits of a mulberry nursery using conventional methods to generate seedlings are displayed in Table 1. Examples of fixed costs are land rental payments and equipment purchases. Variable costs include the cost of buying stem cuttings, clearing the area, constructing the bed, hydrating it and picking weeds before transplanting them into polybags (Bharathi *et al.*, 2023). The total cost is sum up of both fixed and variable values. Fixed costs include the cost of renting land and the cost of purchasing the equipment required to do a specific task. The price of purchasing stem cuttings, preparing the land and beds, irrigation, weeding, uprooting and moving to polybags are examples of variable costs. Those findings are in accordance with findings of Krishnan *et al.* (2014).

For a one-hectare nursery area, the total fixed and variable expenses associated with the traditional stem cutting propagation method were Rs. 30,000 and Rs. 2,34,675 per harvest respectively (Table 1). For conventional technology, the total cost per hectare is Rs. 2, 64,675/-harvest. Revenue of Rs. 6,40,000/-is obtained by the sale of 3,20,000 no. (at 80% survival rate) of saplings at a price of Rs. 2. The entire cost expended was subtracted from the gross income to determine net income. According to Table 1, the net income per acre is found to be Rs. 3,75,325/-per harvest. The benefit-cost ratio was determined to be 1:2.41 based on the data. In typical nurseries, you can generate Rs. 2.41 for every rupee you invest. A project is lucrative if the B:C ratio is greater than 1.

Gross revenue of Rs. 3,20,000/-is obtained through the sale of 3,20,000 no. (with 80 per cent survival percentage) of saplings at a price of Rs. One rupee. It is discovered that the net income per harvest per hectare is Rs. 55,325/- (Table 1). The benefit-cost ratio was determined to be 1:1.20 based on the data. In typical nurseries, you can make Rs. 1.20 for every rupee you invest. A project is lucrative if the B:C ratio is greater than 1. Using the stem cutting procedure, 1,28,000 saplings (no's) were produced in an acre of mulberry nursery land (at 80% survival of 1,60,000 no's/ac). The current outcome is consistent with the findings of Giridhar and Dandin (2014). The benefit-cost ratio for saplings regenerated using traditional methods in a one-acre mulberry nursery was estimated to be 1:1.2 at Rs. 1/sapling (Reddy *et al.*, 2010).

These outcomes are in line with those of Dandin and Kumaresan (2003), who calculated a benefit-cost ratio of 1:1.6 for a one-acre mulberry kissan nursery that marketed saplings for one rupee each. This suggests that mulberry nurseries are making money. The high benefit-to-cost ratio of mulberry nurseries makes them a feasible operation, according to the findings of economic research (Khan *et al.*, 2007). The results presented here were reinforced by Raju and Sannappa (2018). A suggested B: C ratio of greater than one suggests that the project is financially successful (Chandrappa *et al.*, 2000).

Table 1. Expected cost and returns of conventional technology per hectare[using stem cuttings].

S. No	Particulars / Work	Quantity	Rate (Rs)/Unit	Total cost (Rs.)
A.	**Fixed cost**			
1.	Land rental cost (@30,000Rs/acre/yr)	2.5 acres	2.5*10,000 (for 4 months)	25,000
2.	Nursery tools		5000	5000
			Total fixed cost (A)	**30,000/ha**
B.	**Variable cost**			
1.	Land preparation cost	7.5 hours	800	6,000
2.	Bed preparation cost	25 MD	400	10,000
3.	Stem cutting cost	4,00,000nos/ha (1,60,000nos/acre)	0.20	80,000
4.	Transportation cost	-	2500	2500
5.	VAM @ 100g/sq. m	1000 Kg/ha (400 Kg/acre)	30	30,000
6.	FYM @ 20T/ha	20 T	2000/T	40,000
7.	Azospirillum	12.5 Kg	40	500
8.	Planting cost	25 MD*	300	7500

9.	Fungicide	2.5 Kg	1150	2875
10.	Insecticide (250ml)	3	300	900
11.	Weeding	40 MD*	300	12,000
12.	Fertilizer @ 100gm urea / sq. m	1000 Kg/ha (400 Kg/acre)	6.4	6400
13.	Irrigation cost	40 MD	400	16000
14.	Uprooting cost	50 MD	400	20,000
			Total variable cost (B)	**2,34,675/ha**
	Total expense (A+B)			**Rs.2,64,675/ha**
C.	**Returns**			
a.	**Sale of saplings @ Rs.2/unit**			
1.	Sale of saplings	3,20,000 no's/ha 1,28,000 no's/acre @ 80% Survival	2	6,40,000
2.	Gross income (C)/ha			**6,40,000**
3.	Net income/ha		C-(A+B)	**3,75,325**
4.	B:C ratio (@ Rs.2 per sapling)			**1:2.41**
5.	Profit margin per sapling (Rs./unit)/ha			**1.41**
b.	**Sale of saplings @ Rs.1/unit**			
1.	Sale of saplings	3,20,000 no's/ha @ 80% Survival	1	3,20,000
2.	Gross income (C)/ha			**3,20,000**
3.	Net income/ha		C-(A+B)	**55,325**
4.	B:C ratio (@ Rs.1 per sapling)			**1:1.20**
5.	Profit margin per sapling (Rs./unit)/ha			**0.20**

Note: MD – Man; MD* - Women

CONCLUSION

Finding a mulberry nursery's net income and benefit-cost ratio allows one to evaluate its financial viability and economic viability. Nurseries using traditional technology are able to produce three harvests annually thereby need for 90-120 days per harvest provided that resources, space and time are used efficiently. The production cost per sapling for mini clonal nurseries was determined to be Rs. 0.85 for the first harvest and Rs. 0.61 for the second crop while the cost per sapling for conventional stem cutting propagating nurseries was Rs. 0.82. Traditional technology's net income and B:C ratio are Rs. 1,50,890 and 1:2.43 respectively. These economic indicators unequivocally demonstrate that conventional technology-using nurseries are generally more profitable. According to the study, launching a mulberry nursery is a workable strategy for the project participant to start generating revenue. In summary, the economic analysis of stem cutting propagation in mulberry underscores its viability as a cost-effective and efficient method for expanding mulberry cultivation. With careful management and consideration of local factors, this propagation technique can offer significant economic advantages thereby providing a robust foundation for increased productivity and profitability as the seri business industry.

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