

ECONOMICS OF COCOON PRODUCTION AS INFLUENCED BY HYDROGELS UNDER SENSOR BASED IRRIGATION

ABSTRACT

A field experiment was carried out to study the economics of cocoon production as influenced by hydrogels under sensor-based irrigation. The experiment was laid out in Randomized Complete Block Design (RCBD) with nine treatment combinations and three replications by using two different types of hydrogels viz., Pusa hydrogel (T₁- Pusa hydrogel @ 1 kg/ac, T₂- Pusa hydrogel @ 2 kg/ac, T₃- Pusa hydrogel @ 3 kg/ac and T₄- Pusa hydrogel @ 4 kg/ac) and Zeba hydrogel (T₅- Zeba hydrogel @ 3 kg/ac, T₆- Zeba hydrogel @ 4 kg/ac, T₇- Zeba hydrogel @ 5 kg/ac, and T₈- Zeba hydrogel @ 6 kg/ac), and T₉ was control without hydrogel. Total cost of cultivation was more (Rs. 83,173 ha⁻¹ crop⁻¹) in treatment T₄ which received Pusa hydrogel @ 4 kg/ac followed by T₃ (Rs. 81,691 ha⁻¹ crop⁻¹). The cost of cultivation was least (Rs. 77,245 ha⁻¹ crop⁻¹) in T₉ - control plot. Among the different treatment combinations Zeba hydrogel @ 6 kg ac⁻¹ (T₈) treated mulberry leaves fed double hybrid silkworms yielded maximum net returns (Rs. 1,48,812 ha⁻¹ year⁻¹) followed by T₇- Zeba hydrogel @ 5 kg ac⁻¹ (Rs. 1,46,738 ha⁻¹ year⁻¹) and least was recorded in T₉- Control plot without hydrogel (Rs. 1,13,681 ha⁻¹ year⁻¹). However, Zeba hydrogel @ 6 kg ac⁻¹ was found to be cost effective with higher B:C ratio (2.88) followed by T₇- Zeba hydrogel @ 5 kg/ac (2.86) as compared to control which recorded (2.47).

Key words: Tree Mulberry, Sensor based Irrigation, Hydrogels and Economics.

INTRODUCTION

The gap between the demand and supply of water is widening annually, and in the near future, declining availability will be a serious threat to the entire world. It is anticipated that the current 4500 km³ worldwide withdrawal will rise to 6900 km³. By 2030, the estimated availability of water will decline slightly to 4100 km³, resulting in a 40 per cent deficit. Meanwhile, India's annual demand forecast to rise to over 1500 km³, compared to a projected availability of 744 km³, with a 50 per cent deficit (Narasimhan, 2010).

Among all other agronomic inputs, mulberry leaf quantity and quality are most influenced by irrigation water. In sensor-based drip irrigation system applying water to the soil at regular intervals irrigates a specific region surrounding the plant. An irrigation system controller that is already in place can be linked to soil moisture sensors. When an irrigation event is scheduled, the sensor determines the amount of moisture at the root zone. If the soil moisture exceeds a predetermined threshold, the cycle is skipped. The sensors help determine whether irrigation is acceptable and how deep to actually irrigate when they are implanted in the root zone at different places (Hanson and Orloff, 2002).

Depending on the soil type and season, mulberry requires 1.5 to 2.0 acres of water each irrigation at intervals of 6 to 12 days. Aiming for the optimum leaf yield in mulberry, about eight 65-70 day irrigations are needed every crop. Thus, approximately 75 acres of water, or 1875 mm of rainfall spread equally at 36 mm per week or 5–6 mm per day, are needed annually for irrigation water for five crops. However, in India, four to five months rains were received for about eighty percent of the 1,160 mm of annual rainfall on average (Lal, 2001; Gupta and Deshpande, 2004). Therefore, year-round access to water is a problem for producing mulberry leaf with quality and good crop output.

The drip irrigation technique delivers nutrients and water straight to the plant's roots. Higher crop yields, water savings, enhanced fertilizer use efficiency, lower energy consumption, lower labour costs, better disease and pest management, and suitability for sloppy, undulating terrain are some of its main advantages over other approaches. Comparing drip irrigation to traditional flood irrigation techniques, water savings range from 70 to 80 per cent on average (Camp *et al.*, 2000).

Hydrogels also known as hydrophilic gels or super absorbent polymers, fall into a few different categories, including synthetic, semi-synthetic and naturally occurring. In dry conditions with light soil, the majority of these polymers can hold 332-465 times the water content of their weight and release it gradually (Dehkordi, 2016). Because of their hydrophilic nature, hydrogels swell when they come into contact with water, releasing over 95 per cent of the water that has been stored for crop absorption. Depending on the soil conditions and growing method, the super absorbent gels' process of holding and releasing water may take ranging between two to five years. But eventually, without leaving any remnant, it decomposes into CO₂, water, ammonia, and potassium ions over time, making them ecofriendly (Trenkel, 1997).

MATERIAL AND METHODS

The experiment was conducted during 2022-23 in well-established V₁ tree mulberry garden at L- Block, Integrated Farming System Demonstration Unit, University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra, Bengaluru. The field is located at a latitude of 12°58' N, and longitude of 77°35' East and at an altitude of 930 m above mean sea level in the Eastern Dry Zone (Zone-5) of Karnataka. The experiment was laid out in Randomized Complete Block Design (RCBD) with nine treatment combinations and three replications (Plate 1).

Treatment Combinations:

Pusa hydrogel is an indigenous cellulose based product designed and developed to enhance the crop productivity in moisture stress conditions. Whereas, Zeba hydrogel is a unique starch based soil amendment that absorbs water and releases it back to plants when they need it. The dosage of Pusa hydrogel is 1-2.5 kg/ac and Zeba hydrogel is 5 kg/ac.

T₁- Pusa hydrogel @ 1 kg/ac

T₂- Pusa hydrogel @ 2 kg/ac

T₃- Pusa hydrogel @ 3 kg/ac

T₄- Pusa hydrogel @ 4 kg/ac

T₅- Zeba hydrogel @ 3 kg/ac

T₆- Zeba hydrogel @ 4 kg/ac

T₇- Zeba hydrogel @ 5 kg/ac

T₈- Zeba hydrogel @ 6 kg/ac

T₉- Control (Without hydrogel)



Plate 1: View of experimental plot

Economics of applying hydrogels under sensor based irrigation to mulberry and cocoon production.

Cost of cultivation (Rs. / ha): The cost of cultivation was worked out treatment wise. The prices of the inputs that at the time of their use and selling prices of the cocoons on the basis of prevailing market rates were taken into account.

Net returns (Rs. / ha): The net returns per ha was calculated by deducting the cost of cultivation per hectare from gross returns per ha.

Benefit: Cost ratio: Benefit cost ratio was worked out by using following formula

$$\text{Benefit: Cost ratio} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

RESULTS AND DISCUSSION

Economics of applying hydrogels under sensor based irrigation to mulberry and cocoon production.

The acceptance of any technology developed to the farmers ultimately depends on the economics of the crop production. Among the different indicators of monetary efficiency, the economics in terms of net returns and B:C ratio has greater impact on the practical utility and acceptance of technology. Economics of cocoon productivity as influenced by hydrogels under sensor based irrigation on mulberry and silkworm rearing is presented in Table 1.

Total cost of cultivation (Rs. ha⁻¹ crop⁻¹)

Total cost of cultivation was higher (Rs. 83,173 ha⁻¹ crop⁻¹) in treatment T₄ which received Pusa hydrogel @ 4 kg ac⁻¹ followed by T₃ (Rs. 81,691 ha⁻¹ crop⁻¹). The cost of cultivation was least (Rs. 77,245 ha⁻¹ crop⁻¹) in T₉ control plot (without hydrogel) (Table 1).

Net returns (Rs. ha⁻¹ crop⁻¹)

The net returns earned ranged from 1,48,812 Rs. ha⁻¹ crop⁻¹ in treatment T₈ to 1,13,681 Rs. ha⁻¹ crop⁻¹ in T₉. Among the different treatment combinations, mulberry leaves from Zeba hydrogel @ 6 kg ac⁻¹ (T₈) treated tree mulberry fed leaves double hybrid silkworms yielded maximum net returns (Rs. 1,48,812 ha⁻¹ crop⁻¹) followed by T₇ - Zeba hydrogel @ 5 kg ac⁻¹ (Rs. 1,46,738 ha⁻¹ crop⁻¹), T₆ - Zeba hydrogel @ 4 kg ac⁻¹ (Rs. 1,35,644 ha⁻¹ crop⁻¹) and least was recorded in T₉ - Control plot without hydrogel (Rs. 1,13,681 ha⁻¹ crop⁻¹) (Table 1).

Benefit: Cost ratio

The highest B:C ratio of 2.88 was recorded in Zeba hydrogel @ 6 kg ac⁻¹ (T₈) followed by T₇ - Zeba hydrogel @ 5 kg ac⁻¹ (2.86) among the hydrogels lowest was recorded in T₉ - (control plot) which is without hydrogel (2.47) presented in Table 1.

Table 1: Economics of mulberry and cocoon production with hydrogel application under sensor based irrigation

Treatments	Cost of cultivation (Rs. ha ⁻¹ crop ⁻¹)		Total production cost (Rs. ha ⁻¹ crop ⁻¹)	Gross profit (Rs. ha ⁻¹ crop ⁻¹)	Net profit (Rs. ha ⁻¹ crop ⁻¹)	B:C Ratio
	Total cost of leaf production (Rs. ha ⁻¹ crop ⁻¹)	Total cost of cocoon production (Rs. ha ⁻¹ crop ⁻¹)				
T ₁	52,477	26,250	78,727	1,94,935	1,16,208	2.47
T ₂	53,959	26,250	80,209	1,99,492	1,19,283	2.48
T ₃	55,441	26,250	81,691	2,06,874	1,25,183	2.53
T ₄	56,923	26,250	83,173	2,14,894	1,31,721	2.58
T ₅	51,884	26,250	78,134	2,11,157	1,33,023	2.70
T ₆	52,180	26,250	78,430	2,14,074	1,35,644	2.72
T ₇	52,477	26,250	78,727	2,25,465	1,46,738	2.86
T ₈	52,773	26,250	79,023	2,27,835	1,48,812	2.88
T ₉	50,995	26,250	77,245	1,90,926	1,13,681	2.47

The present study is in partial agreement with the findings of Imamsahebet *al.*(2011) who revealed that higher yield (63.78 t/ ha) and net income (Rs.1,14,470.91 / ha / crop), gross income (Rs.1,59,450 / ha / crop) and B: C ratio (3.22) was observed in mulberry genotypes when 100 percent recommended NPK fertilizers was applied through fertigation. Further, Khan *et al.* (1999) found that drip fertigation was found to have a higher net benefit of Rs.38,742 ha per crop with 100 per cent water-soluble fertilizers compared to drip fertigation with 100 percent fertilizer (Rs. 33,604 ha / crop).

CONCLUSION

To conclude, the application of Zeba hydrogel @ 6 kg ac⁻¹(T₈) has shown better results on economics of cocoon production under sensor based irrigation. Starch-based hydrogels can absorb and retain water effectively. They can help in maintaining soil moisture and provide a continuous water supply to plants. Hence, starch based hydrogels like Zeba may serve as best choice for use in mulberry cultivation. Hydrogels play a crucial role in sensor-based irrigation systems by efficiently managing water resources, preventing water wastage and promoting

sustainable agricultural practices. Integrating these technologies can help address water scarcity challenges and contribute to more efficient and environmentally friendly irrigation practices.

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