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IMPACT OF FOGGING SYSTEM IN SILKWORM REARING HOUSES ON COCOON PRODUCTION DURING SUMMER MONTHS IN TROPICAL REGIONS OF TAMIL NADU, INDIA

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Abstract: The impact of maintenance of ample microclimatic conditions in silkworm rearing houses during hot summer in tropical zones by adopting fogging system on cocoon production was studied. There was considerable reduction in incidence of diseases in silkworms and notable improvement in cocoon yield and silk ratio was recorded with the farmers who adopted fogging system when comparable to conventional practices. However, non-adoption of any practice to provide suitable ambience to the silkworm resulted to increase in percentage of disease incidence, poor cocoon yield and silk percentage. Thus, a holistic approach should be made for creating awareness among the sericulture farmers in tropical zones to adopt fogging technology in silkworm rearing houses for sustainable production of cocoon and to fetch more profit during summer months.

Keywords: Silkworm, tropical zones, microclimate, rearing house, fogging system, disease incidence, cocoon production, silk ratio.

INTRODUCTION

The silkworm, *Bombyx mori* L. is a poikilothermic animal, highly sensitive to warm ambient and the atmospheric temperature and humidity play vital role on its growth and development. The temperature and humidity range between 23^0C & 28^0C and 70% & 80% are ideal for silkworms (Dandin *et al*., 2003). In tropical regions, the cocoon production is drastically reduced during summer months because of strike of temperature beyond 40^0C and slash of relative humidity beneath 30%. Therefore, cocoon Productivity and its quality are optimized only when required environmental conditions are maintained inside silkworm rearing sheds besides hygiene and feeding quality mulberry leaves (Sarkar, 2018).

The major silk producing states of India like Karnataka, Andhra Pradesh, Tamil Nadu, Telangana, West Bengal, Odisha, Maharashtra, Madhya Pradesh *etc*., are fall under tropical zones where the warm climatic condition is unfavourable for silkworm in majority of the months. The farmers are traditionally hanging wet gunny cloths around the rearing houses or use electric humidifiers to maintain cool and humid condition inside (Pawar *et al*., 2017). However, management of the microclimate in silkworm rearing houses during the hot summer is an important challenge. Sakthivel (2018) developed and standardized a fogging system for maintenance of ample microclimatic condition in silkworm rearing houses during summer months in tropical zones. Mass trails were thus conducted to find out the impact of the fogging system on rearing parameters of silkworm and cocoon production in Tamil Nadu during hot summer.

MATERIALS AND METHODS

The studies were conducted in potential sericulture clusters in tropical zones *viz*., Salem, Namakkal, Karur, Dharmapuri and Krishnagiri

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districts of Tamil Nadu during 2018 - 2020. The fogging system as described by Sakthivel (2018) was installed with 6 farmers in a cluster covering three clusters per district.

Design and method of installation

Fogging system consists of series of micro sprinklers called foggers. When connected to a high-pressure pump, water is forced through the specialty nozzles and quickly atomized to fine spray which lowers the temperature and increases ambient humidity. In Tamil Nadu, most of the silkworm rearing sheds are constructed with the size of 20-22 feet breadth and 50-120 feet length depending upon the mulberry acreage and rearing capacity of silkworms. Two rows of 5-6 tier rearing racks with 5 feet breadth are arranged to whole length of the shed leaving three lines of foot paths (working space), one in middle portion of the house (*i.e.,* in between two racks) and another two between the both side walls and racks. The fogger system mounted overhead parallel to the foot paths.

Step 1: Three lateral pipe lines with half an inch PVC pipe for water distribution were arranged and fixed beneath the roof, parallel to each foot path (working space) to entire length of rearing house with the help of GI clamps and nails.

Step 2: Foggers were fixed vertically pointing towards floor in each pipeline at a distance of 5 feet using "T" joints.

Step 3: All three lateral water distribution pipelines were connected to a main line.

Step 4: The main pipeline was connected to the outlet of an electrical pressure pump.

Step 5: The suctions pipe (foot valve) of the pump was immersed into a bucket had clean water.

Method of operation

After establishing the fogging system in the silkworm rearing house, the pressure pump was connected to an electrical plug point and switched on for flow of water through the nozzles of the foggers. Then all the nozzles were tuned by turning the screw and proper fogging from each nozzle was confirmed. The fogging system was operated during the period of silkworm rearing except that the time of moulting by silkworms and during cocoon spinning stage. Release of water in the form of fog into the rearing shed bring downs the temperature and increases the relative humidity. At the time of silkworm rearing, micro-climate of the shed was monitored with the help of digital thermo cum hygrometer and the fogger system was operated accordingly in order to maintain ambient climate ideal for silkworm throughout the rearing period as described by Sakthivel (2018).

Design of fogging system in silkworm rearing house

After installation of fogging system, all the farmers were supplied with the FC1 x FC2 double hybrid silkworm, procured from Chawki Rearing Centres (Young Age Silkworm Rearing Centres) locally. The fogging system was used only during the summer months from April to September of every year covering three rearing per year for three years (2018, 2019 & 2020). The data on the performance of silkworm crop including, incidence of disease, cocoon yield and silk ratio was recorded. Parallelly, the similar set of silkworm crops of the farmers in the same cluster who adopting the traditional practices and not adopting any practice (control) for micro climate management in their rearing houses were also monitored and the data were recorded for each crop for comparison. All the data were analysed statistically by using STATISTICA software.

RESULTS AND DISCUSSION

The microclimate management in silkworm rearing houses with the help of fogging system

significantly influenced the silkworm crop. The percentage of disease incidence in silkworms was exhibited lowest and ranged between 2.85 & 6.16, 3.36 & 7.12 and 1.87 & 4.06 during first, second and third crops respectively with the adoption of fogging system comparable to the traditional practices (9.12 & 20.78, 9.47 & 18.05 and 7.50 & 12.76). But there was highest incidence of diseases in silkworms with the farmers who not adopted any microclimate management practice in their rearing houses during summer months with the corresponding values 18.69 & 33.63, 23.66 & 32.73 and 16.27 & 26.20 respectively (Table 1). In all the three crops during summer months, the average cocoon yield (71.26, 70.77 & 73.29 kg / 100 dfls) and silk ratio (22.85, 22.54 & 22.88 %) was improved considerably on adoption of fogging system than the traditional practices (57.87, 53.36 & 53.62 kg/100 dfls & 20.51, 21.07 & 21.51%) whereas non adoption of any practice adversely reflected on the silkworm crop with poor values of cocoon yield (47.46, 42.91 & 46.55 kg/100 dfls) and silk ratio (18.51, 18.99 & 19.98 %) (Table 2 & 3).

Table 1
Influence of fogging system on disease incidence (%) in silkworms during summer months (average of 3 years)

District	*Crop I (April-May)*			*Crop 2 (June-July)*			*Crop 3 (August-September)*		
	Fogging System	*Traditional system*	*Control*	*Fogging System*	*Traditional system*	*Control*	*Fogging System*	*Traditional system*	*Control*
Salem	4.63	13.45	27.76	5.38	12.62	28.49	2.99	7.50	16.27
Namakkal	2.85	9.12	18.60	3.85	9.47	26.14	1.87	9.37	18.00
Karur	6.16	20.78	33.63	7.12	18.05	30.28	3.80	9.12	21.48
Dharmapuri	5.62	15.57	29.24	6.55	16.70	32.73	4.06	12.76	26.20
Krishnagiri	3.89	13.95	18.69	3.36	17.56	23.66	2.50	8.43	20.34
Average	4.63	14.57	25.58	5.25	14.88	28.26	3.04	9.43	20.45
CD@0.05%	0.05	2.85	3.36	0.06	1.28	4.30	0.06	1.11	4.23

Table 2
Influence of fogging system on Cocoon yield (kg/100 dfls) during summer months (average of 3 years)

District	*Crop I (April-May)*			*Crop 2 (June-July)*			*Crop 3 (August-September)*		
	Fogging System	*Traditional system*	*Control*	*Fogging System*	Traditional system	Control	Fogging System	Traditional system	Control
Salem	72.95	58.77	45.88	69.33	55.62	40.17	73.50	60.53	47.53
Namakkal	76.00	63.31	53.60	75.20	58.35	43.73	75.56	55.60	50.76
Karur	67.28	52.94	41.69	66.26	48.00	40.40	69.62	52.84	41.08
Dharmapuri	69.83	56.36	43.82	69.92	54.10	41.33	72.63	48.38	49.12
Krishnagiri	70.25	58.00	52.34	73.16	50.73	48.95	75.17	50.77	44.28
Average	71.26	57.87	47.46	70.77	53.36	42.91	73.29	53.62	46.55
CD@0.05%	9.75	12.75	10.58	11.31	8.25	13.10	11.36	10.06	12.62

Table 3
Influence of fogging system on Silk Ratio (%) summer months (average of 3 years)

District	*Crop I (April-May)*			*Crop 2 (June-July)*			*Crop 3 (August-September)*		
	Fogging System	*Traditional system*	*Control*	*Fogging System*	*Traditional system*	*Control*	*Fogging System*	*Traditional system*	*Control*
Salem	22.82	21.00	18.25	22.96	21.53	18.28	22.07	22.00	19.37
Namakkal	23.60	22.68	19.63	23.75	21.06	18.66	23.52	22.10	20.94
Karur	22.06	19.16	17.95	21.08	20.18	18.19	22.84	21.84	19.65
Dharmapuri	22.80	20.62	17.20	22.60	20.99	19.85	22.95	21.43	19.81
Krishnagiri	23.00	19.13	19.52	22.33	21.61	20.00	23.06	20.20	20.16
Average	22.85	20.51	18.51	22.54	21.07	18.99	22.88	21.51	19.98
CD@0.05%	3.63	3.78	5.16	2.16	3.70	5.84	2.83	3.55	4.48

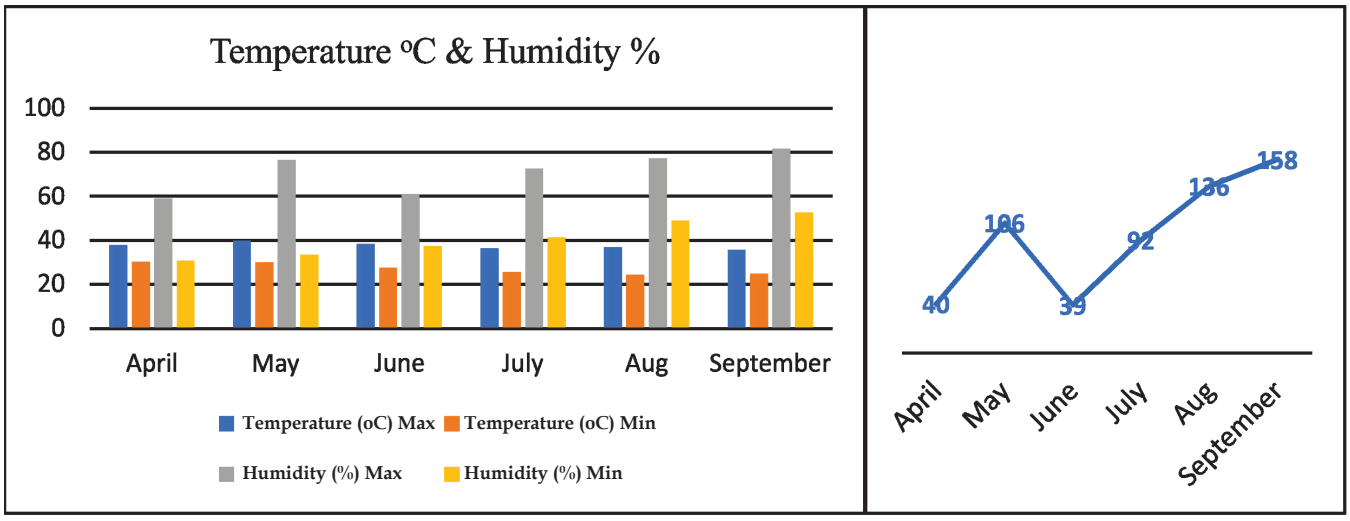

Figure 1: Meteorological data of study area during the experimental periods (Average of three years, 2018, 2019 & 2020)

The study revealed that maintenance of ample microclimatic conditions inside the houses throughout the silkworm rearing period by adoption of fogging system attributed to reduction in disease incidence and notable improvement in cocoon yield and silk ratio comparable to the traditional practices whereas the control farmers met with highest incidence of diseases in silkworms, poor cocoon yield and silk ratio due to adverse effect of high temperature and low humidity during summer months. High temperature during summer directly affects the physiological processes of silkworms (Rahmathulla, 2012). At the same time, it was observed that the lower humidity in the atmosphere quickly desiccates the mulberry leaves offered to the silkworms before ingestion. The poor moisture content in wilted mulberry leaves does not fulfil the water requirement of silkworm for digestion and utilization of ingested food. It weakens the larva as well as its immune system and ultimately the worms become susceptible to the pathogens. This is the reason behind the outbreak of diseases in silkworms and poor cocoon yield and silk quality during hot summer in tropical zones.

Climate change with gradual increase in atmospheric temperature due to global warming becomes a big challenge to sericulture industry. Further, failure of monsoon and water scarcity in many silk producing states also poses serious threats. The silk productivity is slashed abruptly during summer due to the problem of very high temperature and low humidity as many farmers get poor cocoon yield or face crop losses. Further, warm weather prevails in major silk producing states of India during most of the months in a year. Fogger system is found highly effective and reduces rearing house temperatures and increases humidity levels and provides a good solution for maintaining optimum microclimatic conditions than traditional practices. The system helps better growth and development of silkworms and bumper cocoon yield during summer. Hence, mass adoption of fogging system in silkworm rearing sheds in tropical zones could help to improve the silk productivity in a greater extend and could also be a big remuneration to the sericulture farmers.

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