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Climate Change and Its Impact on Sericulture Industry

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Introduction

Sericulture is the science which deals with the rearing of silkworm for the production of the silk. Sericulture and silk industry has a long history of thousands of year as a conventional trade of India, (Bhattacharjya *et al*., 2019). India is the second largest producer of the silk producing 35,468 MT in the year 2018-19 has presented a promising future in coming decades. Silkworms are cold blooded organism, whose body temperature is approximately similar to that of environment, hence the change in atmospheric temperature influence its behavior, development, survival, growth and reproduction. The environmental factors like temperature and humidity determines the successful rearing of the silkworm and the production of the final outcome of this industry, the silk. Since the silkworms are vulnerable to the changing atmospheric temperature and humidity level a slight fluctuation in these factors leads to the complete loss of the crop. Despite of wide fluctuation in the surrounding environmental conditions, some insects show wide range of adaptations to these fluctuations at a tolerable limit but silkworms are unable to survive extreme natural fluctuation. Rising temperature and day to day changing weather patterns links to global warming which becomes the threat to the sericulture industry not only for India but for the other countries which are associated with this industry. Assam, a north-eastern state of India, owing the crown of producing golden silk, at a risk of losing its monopoly for producing it due to this drastic change in temperature. Worldwide attention has been attracted by recent changes in global climatic phenomena and consequent loss of not only muga silkworm (*Antheraea assamensis* Helfer), but also other silkworms too. The effect of climate change on silkworm and other beneficial insects are of greater significance because they are involved in many biotic interactions which play a major role in the ecological functioning as well as they use to contribute a significant amount to the GDP of the country.

Present scenario of climate change:

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Climate is defined as the long term statistical expression of short term weather. Compared to the other planet, our earth's climate is highly unstable as well as unpredictable. A key indicator for climate change is expected global-mean surface temperature increase. According to the recent reports of the Intergovernmental Panel on Climate Change, the global average surface temperature over the 20th century has increased by around 0.60°C (Singh, 2017). The rise in temperature is mainly dependent on the concentration of green house gases like carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (NO_2). On the basis of the increase of greenhouse gases, climatic model predict a 1.4°C to 5.8°C average increase in global warming from 1990 to 2100, probably leading to a more rapid increase in temperature at the surface of terrestrial zones and more extreme local variations (Karl and Trenbeth, 2003).

Effect of climate change on silkworm host plant:

Silkworms are polyphagous in nature and they are solely dependent on their host plants. Quality and quantity of growth and development of the silkworm and their ability to produce silk is highly dependent on the quality of food i.e. on the host plants. We all know that physiological growth and development of a plant depends on different climatic or environmental factors like rainfall, temperature, relative humidity along with the quality of soil where they grow. Due to the change in the climatic conditions, the activity and population of several beneficial microorganisms are affected severely, which is reflected in poor quality of soil and ultimately the poor growth of the host plants. Because of the frequent change in the environmental factors some negative impacts are also found in plant-pest populations. An increase in temperature may resulted in change in geographical distribution, increase over wintering, changes in population growth rate, increases number of generations, extension of their developmental seasons, change in the time of occurrence, changes in the crop-pest synchrony of phenology along with the risk of migrant pest (Ram *et al.*, 2016). Not only the pest, disease occurrences also been reported due to the change in climatic conditions. Coakley and his co-workers reported that with an increase in temperature susceptibility of the plants to rust disease become higher.

Effect of climate change on growth and development of silkworm:

The combination of abiotic and biotic factors describes the overall productivity and fate of silkworm. Silkworms are poikilothermic insect, so these elements have profound

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effect on its physiological activities. Among the four types of commercially exploited silkworm, mulberry silkworm, which is fully domesticated is more sensitive to sudden fluctuations in temperature, humidity and other abiotic factors.Mulberry silkworm (*Bombyx mori* L.) grow normally in the temperature range of 20º- 28ºC and the preferable range of temperature is 23º- 28ºC for maximum productivity (Rahmathulla, 2012). The temperature range of 22-27ºC is more favourable to produce cocoons of good quality and above the range the quality degrades (Krishnaswami *et al*. 1973 and Datta, 1992). Studies have conducted by many scholars (Neelaboina *et al*. and Parrey, 2018) to study the effect of temperature and humidity on mulberry silkworm.The golden silk producer, muga silkworm is semi-domesticated in nature and undergoes 5-6 generations in a year. As it is reared in outdoor condition, slight variations in temperature and humidity can pose a threat to it which leads to crop loss. Autumn and spring are considered as best season for muga rearing to get maximum output. But during the last few years, the temperature is growing in the autumn season, so farmers are shifting the rearing season by 10-15 days during the commercial crop *Katia* (autumn) (Anonymous, 2018). Eri silkworm (*Samia ricini* Boisduval) is completely domesticated, so fluctuations in these factors can be controlled upto some extent. Tasar silkworm is reared in outdoor condition. According to Sinha and Chaudhury (1992), phenological parameters are dependent on ambient temperature and relative humidity during larval and pupal development in tasar silkworm.

Effect of climate change on cocoon production and silk:

For the economical growth of the sericulture industry, quality and quantity of cocoon and silk plays an important role. Proper shape, size and compactness of a cocoon is necessary for filament length as well as the quality of reeled thread. Different characters of silkworm as well as the cocoons are not only influence by the genes but are also by the temperature, humidity, air current etc. Quality of the cocoon and silk is highly influenced by ambient temperature, seasons and other environmental conditions. Change in temperature level affects the quality of the cocoon which results in variation of filament size and quality of reeled thread. According to Srivastava *et al*. (1998), variations occur in cocoon weight, shell weight, filament length, silk yield, denier and sericin percentage due to change in environmental conditions.The influence of temperature on cocoon and reeling characteristics of new

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bivoltine hybrids during spinning period (Gowda and Reddy, 2007). Since proper information and field studies are not available

Conclusion:

The creation of nature cannot be changed or manipulated. The use of pesticides, industrial growth is some of the factors contributed to change in climate. Man has to develop alternatives to cope up with this. Climate change has its impact on sericulture industry in various ways. To avoid crop loss during rearing in case of muga silkworm, indoor rearing can be conducted for early stage worms. Rearing can be done inside nylon nets to avoid heavy rainfall and pest infestation. For mulberry silkworm rearing, temperature control system can be installed to avoid crop loss. Now a day, shifting of rearing season in case of muga is accepted by the farmers to mitigate the loss. Regarding the food plants, frequent care should be taken by checking soil quality and pest infestation, providing adequate amount of manures and fertilizers, pruning and pollarding. Care should also be taken during spinning of cocoons by maintaining required temperature and humidity throughout the period. As the exact effect of climate change on sericulture industry is not yet proven, so on the basis of available research findings future researches need to be conducted in this areas for the benefit of this industry. There is dire need to combat this emerging problem with some sustainable measures to safeguard our resources.

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