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Anthropogenic activities threatening MUGA culture in assam

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Abstract

Muga culture is endemic to India. Despite being the major means of livelihood of people across Assam, the industry is imperilled by the anthropogenic activities as oil and gas mining, smelting, petroleum explorations, transport, storage, cement manufacturing, etc leading to deposit of ponderous load of aliphatic and aromatic hydrocarbons and heavy metals in soil, air, water. The pollutants generated deteriorate the soil, plant and human health leading to abandonment of areas adjacent to oil refineries. Additionally, the venerable practice of muga rearing is compromised. The worms suffer high larval mortality and premature death. Carbohydrate and protein requirement of worms is not met. This review briefly highlights the adverse impact of pollutants muga ecosystems bordering the oil mining areas in Assam. The prejudicial effect of pollutants and heavy metals on muga host plants, lifecycle, and biology of muga worms and consequently on the performance on muga silk industry is also discussed.

Keywords: Anthropogenic, Heavy metals, Muga silkworm, Pollutants

Introduction

India (land of endemism) hosts many rare yet economic species of insects. Muga silk worm, *Antheraea assamensis*, (an exclusive elite of Assam) is one among them, yielding golden yellow lustrous silk fabrics that was well reputed with the GI (Geographical Indication) tag in 2007. Assam is also an emerging player in crude oil extraction and petroleum exploration industry. Although, the above two activities generate employment and economic gains to the state, they do not seem to operate in harmony. Crude oil spills during extraction and mining, transportation, storage is known to adversely affect the muga silk culture in the adjoining areas. Similar anthropogenic activities as metalliferous mining, oil, and gas explorations, etc have led to the easy permeation of aliphatic and aromatic hydrocarbons, heavy metals and trace elements in the soil, water, and air threatening muga sericulture in its most endemic area.

Contaminants

Crude oil contains aliphatic hydrocarbons (C_1-C_{40} straight chains) and branched chains (C_6-C_8) compounds, aromatic compounds, cyclohexane, heavy metals (lead, arsenic, mercury, cadmium, chromium), trace elements (Zinc, copper) apart from nitrogen, oxygen, and sulphur (Devi *et al.,* 2017). These pollutants enter and contaminate the environment through spill and leakages, during transport or evaporate from open fields and mining areas or storage tanks. Seepage of pollutants degrades the quality of ground and surface water and limits its suitability for agricultural use or irrigating muga host plants. PM2.5 (air borne particulate matter <2.5µm) cause respiratory illness and are more detrimental as compared to PM10 (air borne particulate matter <10µm) (Devi *et al.,* 2014).

Impact on plant

The heavy metal accumulation in plants retards their palatability and suitability for the muga culture. The pollutants enter the plant via 2 routes: wind dispersion and settlement on the leaves impairing the feed quality of muga worms or may enter the plant through their deposition in irrigation water and soil horizon (Islam *et al.,* 2017). Following the accumulation of pollutants, there are various structural and functional changes that the foliage may witness. The total carbohydrate and protein content of the leaves decline, threatening health and survivality of the worms that consume them (Devi *et al.,* 2014). The oils deposited in the soil may be taken up by the roots of Som plants and these oils on reaching leaves absorb the essential nutrients that are not available for the larval growth. The aliphatic- aromatic hydrocarbon level in the leaves 5.44-125.4mg/Kg at contaminated site and 3.07mg/Kg at the uncontaminated control site (Devi *et al.,* 2017). Leaves at the polluted site have lower photosynthetic rate leading to low carbohydrate accumulation. The decline in leaf protein content was seen owing to protein denaturation and breakdown on exposure to heavy metals.

Impact on soil

The accumulation of particulate matter from the oil exploration activities in environment adversely affect soil health by degrading beneficial soil microflora. There is complete destruction of the soil texture, structure, and composition due to presence of heavy metals and organic pollutants (Devi *et al.,* 2015). While the aliphatic- aromatic hydrocarbon level range from 17.01 to 59.42 mg/Kg in the contaminated site, the maximum level of those hydrocarbons in the uncontaminated site was 11.2mg/Kg (Devi *et al.,* 2017). The available nitrogen and sulphate concentration in the soil also drops down due to oil contamination.

Impact on human health

PAHs (Polycyclic aromatic hydrocarbons), POPs (Persistent Organic Pollutants) and BTX (Benzene, Toluene, and Xylene) generated from mining are carcinogens of high threat and have potential public health risks. VOCs (Volatile Organic Compounds) aid in the formation of ozone and alter the physiochemical properties and oxidising potential of troposphere. PHAs (polyhydroxyalkanoates) as anthracene though not carcinogenic, but has high phototoxicity (Devi *et al.,* 2017), meaning exposure to such chemicals makes the dermal tissues susceptible to the action of harmful radiations of sun.

Impact on MUGA culture

Muga culture is a major economic activity of the people in Assam. It is the means of livelihood of people residing in and around the oil fields in Assam. It is a semi-domesticated, polyphagous, multivoltine worms that mostly feeds on Som (*Machilus bombycina*) and Soalu (*Litsea polyantha*). Impact of organic hydrocarbons and pollutants on the growth and proliferation of host plants of muga silkworm is the most crucial reason for decline in muga production across the state. Insects in general are poikilothermic animals, meaning that the surrounding environment and the quality of food offered has a crucial role to play in their growth and development (Devi *et al.,* 2015). n-alkanes (C_{22}-C_{35} associated with PM2.5) in the finer air particulates are highly detrimental for muga (Devi *et al.,* 2014). Heavy metals (cadmium and lead) induce production of ROS (Reactive Oxygen Species) that causes damage to biomolecules and DNA of the cell (Islam *et al.,* 2017). PHAs as phenanthrene and fluoranthene are highly detrimental for the muga worms on consumption or inhalation (Devi *et al.,* 2017). Muga silk worm larvae are known to suffer from stomach and skin cancer and ulcers and exhibit lowered immunity on exposure to various levels of PHAs. m-Xylene (most toxic VOC from petroleum industry) in the leaf samples induces high larval mortality. BTX particularly benzene is highly toxic and have long term persistence in ecosystem and impair the excretory and nervous tissues of the larvae (Devi *et al.,* 2017). The larvae witness low cholesterol, reduced protein and lipids, low haemocyte count and less overall body weight. Muga worms in the adjacent areas of oil refineries are reported to have premature death before reaching the spinning stage leading to severe crop losses (Islam *et al.,* 2017).

Conclusion

It is evident that anthropogenic activities and human interference have threatened the muga silk industry that yields one of the most luxurious class of fabrics. Muga worms being highly sensitive to the persistent organic and inorganic pollutants and fine particulates in the atmosphere, are adversely affected. Such activities disdain the potential of Muga silk sector declining its production and productivity. Therefore, devising suitable strategies to protect environment and remediation of the polluted sites is a dire necessity. Further, upscaling the resistance of muga worms and host plants to tolerate exposure of heavy metals and sequester them, raising antioxidant production and minimalizing ROS mediated damage could help in reviving the Muga sericulture in North-eastern states of the country.

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