

## **SPIDERS FOR ERRADICATION OF VECTOR BORNE DISEASES**

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Spiders are generalized feeders which prefer to feed on any arthropods preferably the mosquitoes which may or may not be vectors. They are voracious feeders and feed ten times their body weight daily. They can feed on aquatic larvae as well as the adult flying mosquitoes/insects. Spiders feeding on mosquito larvae are the members of spider families- Tetragnathidae, Lycosidae, Pisauridae, Trechaleidae which inhabits close to the water bodies. Other spiders mostly salticids (jumping spiders), araneids, clubionids, eresids, pholcids, oxyopids which are found in and around human inhabitants feeding on flying and sitting adult mosquitoes.

Spiders generally show a strong co-existence with plants. Mosquitoes, also mostly inhabits the shrubs and trees and therefore; spiders easily prey upon the mosquitoes.

There are 112 families of spiders in the world with 43,678 described species, this is thought to represent only a fraction of their total diversity. In India, about 1686 spider species are known from 60 families. Certainly, spiders are ubiquitous in terrestrial ecosystems and many taxa also occur in freshwater and many more inhabit near ditches and ponds and in riparian habitats.

### **Life cycle of most of the insects/ mosquitoes and spiders coincides:**

The life span of most of the spiders range from 8 to 10 months and their life cycles mostly follow the periods of life cycles of mosquitoes, as both of them prefer humid and warm environments.

### **High fecundity and less mortality in spiders:**

Spiders lay egg sac containing 60 to 500 eggs and many a times a spider lays 4 to 5 egg sacs, indicating tremendous egg laying capacity. Generally mortality is less in normal circumstances unless and until some natural calamities occur.

### **Spiders are safe to use and handle:**

There is a misbelieve about spiders that they are venomous. Yes, to some extent. However, as the quantity of venom is too less, it never shows any deteriorating effect on human body. It is enough to paralyse the insects, frogs, birds and even lizards but there is absolutely no effect on human beings. Researchers at Arachnology museum at SGB Amravati University are handling spiders in their hands fearlessly

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since long and there has not been a single incident of any harmful effect of spider bite. Even they do not bite if handled carelessly.

**Spiders feed on larvae as well as adult mosquitoes/vectors:**

Ximena *et al.* (2005) studied the behavior of jumping spiders and found that they possess innate predisposition to adopt *Anopheles*-specific prey-capture behavior. They proved that the spiders can recognize the sitting posture by which the small juveniles of jumping spiders identify *Anopheles*.

**Spider venom can provide a solution against *Plasmodium*:**

Malaria constitutes the most widespread infectious disease, affecting over 300 million people (Snow *et al.* 2001, 2005). Resistance of *Plasmodium* species to classical anti-malarial drugs is becoming a critical problem and new drug targets against *Plasmodium* are urgently needed. Searching for these targets requires a better understanding of the *Plasmodium* biology and interaction with its host.

Psalmopeotoxin I (PcFK1) is a 33-amino-acid residue peptide isolated from the venom of the tarantula *Psalmopoeus cambridgei*. It has been recently shown to possess strong antiplasmodial activity against the intra-erythrocyte stage of *Plasmodium falciparum in vitro*. What is important is, this peptide does not lyse erythrocytes, is not cytotoxic to nucleated mammalian cells, and does not inhibit neuromuscular function (Pimentel *et al.*, 2006).

Recently an incident took place in Pakistan indicating the importance of spiders in malaria control. During the second half of 2010, Pakistan was severely affected by floods. Immediately after the flood most of the trees and shrubs were covered with spider webs. As flood waters endured, and remained stagnant, there was a considerable fear among Pakistani authorities that malaria would spread in the general population, due to the massive numbers of mosquitoes that could develop in the water. But that didn't happen. The massive webs that the spiders had spun were apparently too appealing to millions of mosquitoes that met their end in the trap-trees the spiders set up for them. The number of malaria vectors was therefore significantly reduced and people got protected.

Mosquito borne diseases continue to be a major problem in almost all tropical and subtropical countries in the present era of climate change. They are responsible for the transmission of the pathogens causing some of the most life – threatening and debilitating diseases of man, like malaria, yellow fever, dengue fever, chikungunya, filariasis, encephalitis, etc. Biological control has a very positive role to play in the integrated control methodologies in which both pesticides and fish or other biotic agents have their own roles. Biological control refers to the introduction or manipulation of organisms to suppress vector populations. A wide range of organisms helps to regulate mosquito populations naturally through predation, parasitism and competition. As biological mosquito control agents, larvivorous fish are being used extensively all over the world since the early 1900s (pre DDT era). However, the

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services rendered by spiders in natural predation are neglected. With this above background, it is thought to take advantage of spiders in controlling the vector/ mosquito population at larval as well as adult stages.

### **Spiders can be reared:**

Yes, spiders can be reared easily in laboratories and farms successfully. Once reared, they can be released like those of Guppies. The advantage is, spiders have high fecundity rate and are easy to rear, handle and transport. There is zero risk. We have had several experiments in our lab for these and they are found to be successful.

### **India has rich spider diversity:**

During last three years, the Arachnology Museum of SGB Amravati University has a collection of more than 1400 different spider species. Fortunately India shows spider diversity in an order of salticids>thomisids>araneids>gnaphosids>lycosids and hence, spider advantage can be taken to control all types of vectors. All riparian habitats in India have a rich population of tetragnathids and pisaurids which are sufficient to feed on the mosquito larvae, if reared spiders are released in the habitats like the edges of ponds, lakes, reservoirs and ditches which form favourable niches for these spiders. In one such habitat of India, a huge population of tetragnathids, *Euzygiella* and *Larinia* were found in huge colonies (fig. ) During these days of uncertain seasons and heavy rains in short span, which results into floods and formation of ditches, the high fecundity breeders like eresid spiders can be at rescue. The breeding period of these spiders is from September to November and after that they get scattered in all surrounding areas feeding heavily on mosquitoes/vectors.

### **How the project can be implemented?**

**Establishing rearing centers:** Rearing centers can be established at taluka places or district places taking the help of University departments which can be provided grants. Initially, a training program is required for the researchers/rearers. My University can be a nodal agency for training and research.

**Releasing spiders:** A team of employees of vector borne diseases can do this job preferably during evening hours.

**Organizing awareness programs:** Generally, there is an arachnophobia. People have to be made aware about the role of spiders in nature. Workshops, training programs are to be organized. Literature can be published in the form of booklets/ handouts etc.

### **Advantages over larvicidal fishes:**

There are several disadvantages of using larvivorous fishes like *Gambusia* which when stocked in waters outside their native range, often causes serious

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negative ecological impacts. *Gambusia* is an opportunistic predator with a highly variable diet that includes algae, zooplankton, aquatic insects, as well as eggs and youngones of fishes and amphibians.

Thus, mosquitoes are and will be the major concerns to come. Biological control is expected to play an increasing role in vector management strategies of the future. The technology is challenging as well as difficult. Unlike the chemical pesticides, the results are often unpredictable with biological agents. This calls for a better understanding of the biological interactions with the environment. Developing and acquiring the necessary skills assume paramount importance. Another important consideration is the recognition of the fact that, in developing countries like India, success of such strategies depends on developing simple technology backed by a campaign of public education. Interventions targeting vectors of diseases are essentially the most effective strategies to control vector-borne diseases. And spiders carry the potential for overcoming such obstacles.

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