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Wolbachia: a friend or foe for Uzi flies

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1. Short Note

The Uzi fly, *Exorista sorbillans* a tachinid endo-larval parasitoid of silkworm, *Bombyx mori* causes severe loss to the farming community of India. The exponential multiplication of this pest has alerted the number of scientist since three decades, though complete curable measures for this fly pest has not been investigated. In this direction, scientists are investigating integrated approach for the management of the Uzi fly. Here we have investigated totally new approach for the management of the fly pest by using *Wolbachia* endobacteria [1-3].

The bacteria of the genus *Wolbachia* have been recently recognized to infect a wide range of arthropods including insects, mites, isopods and filarial nematodes [4, 5]. The intracellular bacteria were first reported from the culicine mosquitoes *Culex pipiens* by Hertig and Wolbach in the year 1924 and later named it as *Wolbachia pipientis* by Hertig in the year 1936 in the honor of his collaborator Wolbach. Later it was found that, these bacteria were not only infects mosquitoes but also infects *Drosophila* and subsequently many more insects. Now it is known that these bacteria infects 16 – 76% of all know insect species [6-9].

These bacteria manipulates the host reproductive biology in many ways such as parthenogenesis induction, in which infected virgin females produces only female offspring; male killing in which infected male embryo die during embryogenesis; feminization, in which infected genetic males converted into functional females; fecundity enhancement, in which infected females produces more eggs than that of uninfected females [10, 11]. The best studied and most common effect is cytoplasmic incompatibility, wherein a cross between infected male and uninfected females results in the mortality of the embryo [4, 5]. Other effect includes pathogenicity, where *Wolbachia* blocks pathogen there by provide resistance to the hosts [12, 13]. The manipulation of host biology and the expected response of host genes have important implication for the management of insect pests of agriculture and vectors of human as well as veterinary diseases.

From the application point of view, *Wolbachia* is of interest as a tool to genetically transform insects for the manipulation of their disease causing abilities and in controlling pests and predators by interfering with their *Wolbachia* symbionts [14]. Though it has not been possible so far to culture in a cell free medium and reinfection is possible through microinjection. Further, it was found that feeding antibiotics (Fig. 1) or exposure to elevated temperature leads to elimination of *Wolbachia* either immediately or in subsequent generations [1-3].

These unique abilities of *Wolbachia* in manipulating insect reproduction has led to use it as powerful tool to control of pests and disease vectors throughout the globe at various extent due to increased awareness about environment and public health concern. So it has gained momentum during recent years. Keeping these in view, we have exploited the *Wolbachia* induced reproductive manipulation in Uzi fly, *Exorista sorbillans* [1-3]. We have detected two super clade *Wolbachia* in Uzi fly [15, 16], which manipulates reproduction differentially. The most important one is unidirectional cytoplasmic incompatibility between infected males and uninfected females (Fig. 1), and bi-directional cytoplasmic incompatibility among natural populations experienced with varied climatic conditions and crosses among different age group flies [16]. The *Wolbachia* infected Uzi fly display mutualism, where the Uzi fly provides shelter and other requirements for survival and transmission of *Wolbachia* while the *Wolbachia* enhances the reproductive fitness and survival of Uzi fly.

The presence of two super clade *Wolbachia* in Uzi fly induces expression and evolution of different levels of cytoplasmic incompatibility. This is mainly due to the expression of different levels of modification and rescue factors (*mod/resc)* in males and females respectively by *Wolbachia*, which is specific for specific *Wolbachia* strains that increases the interaction highly complex.

Further extension of the study displayed fecundity enhancement in infected females up to 17–26% [1-3, 11]. This may be due to increase their transmission via increased offspring production. Our detailed study on oogenesis showed that it has effect on oocyte metabolism, such as, oocyte production, oocyte differentiation and development [11], further showed that antibiotically cured individuals have stunted growth of ovarian tubule (Table 1). Continued observations showed that the uninfected females display sex ratio distortion of 2:1 male-female ratio [1].

From all these studies, a method has been developed to curtile the Uzi fly menace on silkworm by administering *Wolbachia* targeted tetracycline via its silkworm hosts diet [2]. The tetracycline by affecting the intestinal microbial flora, not only influenced the larval growth of the silkworm by decreasing larval duration almost a day, increasing silk production and fecundity with normal hatchability besides it decreases

the reproductive fitness of the Uzi fly endoparasite by killing or altering the *Wolbachia* density [2].

These studies potentially demonstrate that the possibility of using *Wolbachia* for Uzi fly management in silkworm rearing environment to enhance the silk production in India where sericulture employing six million farming folks. Therefore, the *Wolbachia* is a friend for Uzi fly in natural conditions and also an enemy in an adverse condition.

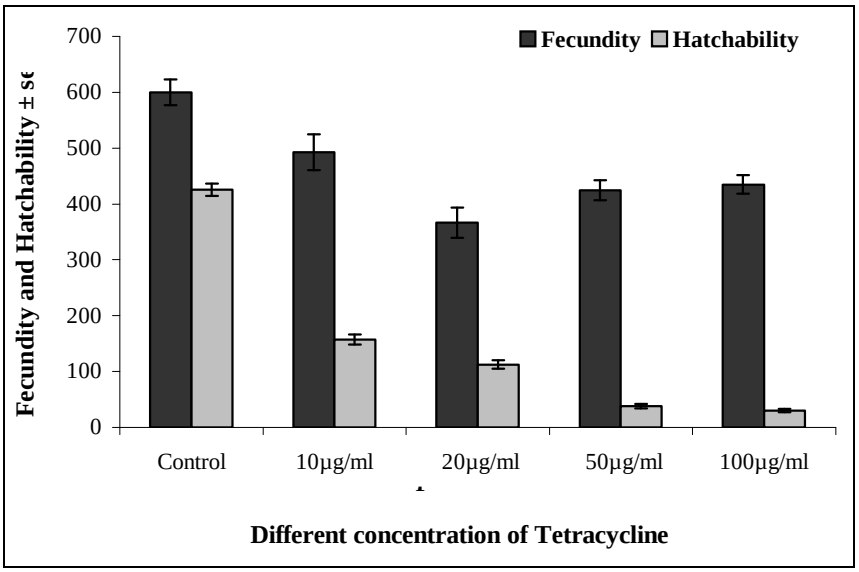

Fig 1: Graphical representation of CI level in different concentration of tetracycline. We administered tetracycline for three generation, after that we reared Uzi flies without tetracycline for three generation and then crosses were made as untreated control males with different concentrations of tetracycline treated females such as 10, 20, 50 and 100 µg/ml of tetracycline to test the efficacy of tetracycline on Uzi fly *Wolbachia*. Finally we found that 50 µg/ml of tetracycline were suitable for curing *Wolbachia* in the Uzi flies that reported elsewhere [1].

Table 1: Length of ovarian tubule in *Wolbachia* infected and uninfected adult Uzi fly, *E. Sorbillans* population of freshly eclosed to sixth day old flies. The detailed description of experimental protocol can be seen elsewhere [11].

Status	Length of ovarian tubules						
	FEF	**1 - DF**	**2 - DF**	**3 - DF**	**4 - DF**	**5 - DF**	**6 - DF**
Infected Uzi fly Mean ± se	1260±60.50	1767±43.65	2170±97.88	3321±61.32	3710±132.97	4260±164.2	4780±104.21
Uninfected Uzi fly Mean ± se	1170±28.12	1431±57.0	2229±174.2	3140±110.0	3263±26.563	3589±163.0	3730±112.68
df (n=10)	19	19	19	19	19	19	19
t-value	1.66	5.05	-0.38	2.16	3.18	2.55	6.29
Pearson Correlation	0.44	0.14	0.48	0.65	-0.199	-0.29	-0.18
***p*-value**	<0.13	<0.0007	<0.71	<0.06	<0.01	<0.03	<0.0001

FEF-Freshly emerged fly; DF-day fly

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