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Resistance development status in tea mosquito bug (*Helopeltis theivora*) against certain insecticides

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Tea plantations in Central Travancore are susceptible to various pest attacks, which affect adversely both productivity and quality of tea. Damage due to tea mosquito bug, (*Helopeltis theivora*) in Kerala (South India) resulted in 4 to 46 per cent crop deprivation (Muraleedharan, 1992). Among the tea pests, *H. theivora* is an economically important pest in this region and migration of this pest to other tea growing regions is also reported (Muraleedharan, 1992). Tea mosquito bug attack will cause immediate crop loss and affected bushes are vulnerable to subsequent attack of leaf blight caused by *Pestalotia theae*, a secondary wound pathogen. In north east India, 80 per cent of the tea plantations are affected by this pest which in turn reduces the productivity by 10 to 50 per cent (Gurusubramanian and Bora, 2007). Many insecticides are being used in tea plantations against this pest. Repeated application of the same insecticides may lead to the development of insecticide resistance. The development of resistance was noticed in populations of *H. theivora* in North-East India (Roy *et al*., 2008b; Gurusubramanian and Bora, 2007). No systematic data is available on the resistance development of tea mosquito bug in Central Travancore. Hence, a study was conducted to assess the potential of resistance development in *H. theivora* to the commonly used insecticides.

The field collected adults and nymphs of *H. theivora* were reared in the insect cages in the laboratory at 25±2 °C room temperature and 70 to 80 per cent relative humidity on a susceptible tea clone, UPASI-9, by following the method of Sudhakaran and Muraleedharan (2006) without exposing to any insecticides upto twelve generations and the population of 12th generation (F12) was used as control. Quinalphos 25 EC, chlorpyrifos 20 EC, profenofos 50 EC, endosulfan 35 EC and monocrotophos 36 SL were evaluated against the laboratory reared as well as field collected population of tea mosquito bug. Different concentration of test solutions were sprayed on the freshly collected tea shoots with the help of glass atomizer. Treated shoots were air dried and placed in glass bottle with water. The glass bottle containing tea shoots (10 shoots/bottle) were placed in a ventilated plastic container (30 x 15 cm). Thirty adult *H. theivora* per treatment were released in separate containers of 10 each per container. Data on adult mortality was recorded after 24 hours of treatment. The mortality data were converted to corrected percentage mortality by using Abbott's formula (Abbott, 1925). The LC_{50} value was calculated by adopting probit analysis (Finney, 1971). The resistance status was obtained using the method suggested by Wegorek *et al*. (2009). Resistance status was recorded as per the following scoring pattern RC <1 - lack of resistance; RC 1.1 to 2 low resistance; RC 2.1 to 5 - medium resistance; RC 5.1 to 10 - high resistance and RC >10 - very high resistance.

The LC_{50} value and resistance ratio of the five different insecticides for the susceptible laboratory population (F12) and field collected population of tea mosquito bug is furnished in Table 1.

Tea mosquito bug collected from the field showed higher LC_{50} for all the tested insecticides when compared to the laboratory susceptible population (F12). This is in accordance with the earlier findings of Roobakkumar *et al*. (2011).

Table 1. Resistance level of *Helopeltis theivora* in central Travancore

Insecticide	Population	LC 50 (95% Confidential limit)	RR*
Quinalphos 25 EC	F12	275.73 (265.40-286.48)	1.02
	F1	280.22 (272.80-287.84)	
Chlorpyrifos 20 EC	F12	138.45 (128.60-149.05)	1.12
	F1	154.57 (138.87-170.81)	
Profenofos 50 EC	F12	71.53 (68.44-74.74)	1.20
	F1	82.62 (74.24-91.93)	
Endosulfan 35 EC	F12	64.90 (55.72-75.58)	1.05
	F1	68.03 (59.72-77.50)	
Monocrotophos 36 SL	F12	26.16 (22.44-30.51)	1.04
	F1	27.10 (21.67-33.89)	

F1: Field population, F12: 12th Generation laboratory population
*RR: LC_{50} of field population (F1) /LC_{50} of laboratory susceptible population (F12)

Irrespective of the group to which insecticides belong, evidence of development of resistance to synthetic pyrethroids, organophosphates, organochlorines and neonicotinoids has been experimentally proved in the tea mosquito population of Dooars, West Bengal and Jorhat, Assam (Rahman *et al*., 2005; Sarker and Mukhopadhyay, 2006a; Gurusubramanian and Bora, 2007; Bora *et al*., 2008; Gurusubramanian *et al*., 2008a).

In the present study, resistance ratio of quinalphos, chlorpyrifos, profenofos, endosulfan and monocrotophos were 1.02, 1.12, 1.20, 1.05 and 1.04, respectively. Among the insecticides tested, profenofos had higher resistance value, which indicates development of resistance by tea mosquito bug. *H. theivora* populations resistant to commonly used insecticides were found in some parts of India, such as Assam (Gurusubramanian and Bora, 2007; Gurusubramanian *et al*., 2008a) and Dooars (Roy *et al*., 2008a, 2008b). The development of resistance in insects to insecticides was mainly induced by the frequency of insecticide application (Ay and Yorulmaz, 2009). All other insecticides had lower resistance value indicating marginal development of resistance.

Higher resistance value of profenofos was followed by chlorpyrifos, endosulfan, monocrotophos and quinalphos. According to Roy *et al*. (2009 & 2010), the resistance ratio for the fifth generation of *H. theivora* was increased 4.4 fold against endosulfan as compared to first generation. In addition, qualitative and quantitative changes were recorded in the enzyme pattern of the tea mosquito bug (general esterase - Sarker and Mukhopadhyay, 2003; glutathione S-transferase and acetylcholinesterase - Sarker and Mukhopadhyay, 2006c), red spider mite (general esterase - Sarker and Mukhopadhyay, 2006a) and looper caterpillar (general esterase - Sarker and Mukhopadhyay, 2006b) indicated a higher tolerance/ resistance status due to formation of greater amount of esterases, glutathione S-transferase and acetylcholinesterase. One of the main reasons for higher tolerance or resistance by tea mosquito bug and red spider mite to different pesticides was due to mixing of incompatible insecticides with acaricides to combat mixed infestation which, not only decreased the insecticide toxicity but also shifted the level of relative toxicity (Rahman *et al*., 2005). Gurusubramanian *et al.* (2008) reported that a pronounced shift in the level of susceptibility of *H. theivora* to thirteen insecticides from the recommended dose level.

According to the formula of Wegorek *et al.* (2009), all the tested insecticides are coming under the low resistance status. However, rotational use of insecticide is necessary to prevent the development of resistance against the recommended insecticides.

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