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Ultrasound: A Potential Tool for Management of Tea Mosquito Bug, *Helopeltis theivora* Waterhouse (Miridae:Hemiptera)

ABSTRACT : Ultrasound may be a potential components of IPM for *H. theivora* which suffered early mortality when exposed to 20 KHz frequency for 15, 30 and 45 minute per day from 1st instar onwards. Oviposition rate and hatching were 0.437±0.12, 0.645±0.15 eggs/female/day and 4.76±0.46%, 16.67±2.89% when exposed for 30 and 15 minute per day, which were 1.09±0.23 egg/female/day and 95.45±8.24% for control.

Key words: *Helopeltis theivora, ultrasound, tea, fecundity, mortality*

Tea industry in India, a significant contributor to the national economy faces significant challenges from the insect pests, notably tea mosquito bug, *Helopeltis theivora* Waterhouse (Hemiptera:Miridae)[1-3], which cause 11-100% crop loss[4]. Both the nymphs and adults of the pest suck cell sap from tea leaves causing circular necrotic spots. Under severe infestation, the leaf curl up, desiccate and sprouting of new leaves were inhibited[5]. Female deposits eggs mainly on stems and few eggs may also be deposited on leaf veins. Several insecticides are being used to suppress its population; but the outcome is not encouraging. Instead many side effects of pesticides including residues in tea drinks have emerged as serious problem[5].

Ultrasound of frequency higher than human hearing (>16 kHz), was found to be effective in controlling insect pests[6]. Although, its applicability under field conditions has not been worked out, yet it may offer a potential alternative component of integrated pest management (IPM) of tea.

We made an attempt to understand the effect of ultrasound on the feeding, mortality and reproduction of tea mosquito bug.

Materials and Methods : Tea mosquito bugs were reared at the North-East Institute of Science & Technology as per the method described by Bhuyan and Bhattacharyya[3].

In each day, the tea mosquito bugs were detached gently with camel hair brush from the twig and exposed to ultrasound using a high High Intensity Ultrasonic Processor (Model: VCX 500, Make: Sonics & Materials Inc, USA) which produced 20 KHz ultrasound frequency with amplitude of 21% and pulse on, off ratio 3.5:1.5, for 15 min, 30 min and 45 min inside the chamber[6]. Five nymphs on a twig constituted one replication and 10 such replications were considered for each of the three treatments. Similarly, a control was maintained with same number of insects and replication without any ultrasound exposure. Number of lesions produced by individual insects

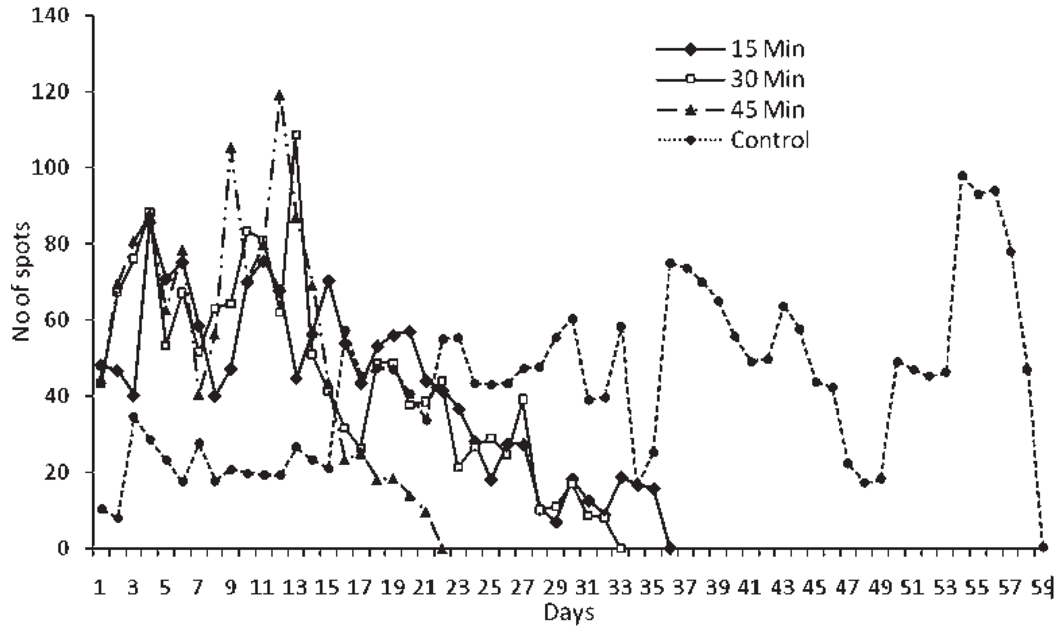

Fig. 1. Effect of ultrasound on feeding of *H. theivora*

and their mortality, if any, were recorded daily. Fecundity of ultrasound exposed and control insects and egg hatching were observed and recorded. Analysis of variance (ANOVA) test was applied to ascertain treatment effects[7].

Results : *Effects on Feeding and Longevity :* The results indicated that ultrasound had considerable effect on *H. theivora* feeding (Fig. 1). Although initially high, however, number of feeding spot produced by ultrasound treated insect reduced abruptly after 17 to 20 days. It was also noted that insects exposed to ultrasound for 45 min produced highest no of feeding spot initially than that treated for 30 and 15 min. Therefore, the initial effect of ultrasound on the feeding was in the order of 45 min > 30 min > 15 min > control.

Ultrasound caused early mortality for *H. theivora* than the control insects (Fig. 1 & 2). In the case of 45 min exposure to ultrasound, all bugs died within 22.5 days, while control insects lived for 55 days. Similarly, all bugs treated for 30 min and 15 min died within 33.5 days and 36.5 days respectively (Fig. 1). Mortality of ultrasound exposed bugs was influenced by the duration of ultrasound. Most of the bugs exposed for 45 min died within first 5 days followed by 30 min and 15 min ultrasound treated bugs.

***Effects on Fecundity and Egg Hatching* :** Bugs treated with ultrasound for 45 minutes did not lay eggs although they lived for 7 days as adult. However, bugs exposed to ultrasound for 30 min and 15 min laid 0.437±0.12 and 0.645±0.15 eggs/ female/day respectively (Table 1). The rate of egg laying of treated bugs decreased significantly in comparison to control (1.09±0.23). Significantly lower percentages of eggs laid by ultrasound exposed bugs hatched (4.76±0.46% and 16.67±2.89% of 30 min and 15 min exposed) compared to that of control insects (94.45±8.24%). Results indicated an inverse relationship between fecundity and time of exposure to ultrasounds ($p<0.05$).

TABLE 1. Effect of ultrasound on fecundity and hatching of *H. theivora* (P<0.05)

Exposure Time	Egg deposition rate (no./female/day)*	Egg hatching (%)*
15 Min	0.645±0.15[a]	16.67±2.89[a]
30 Min	0.437±0.12[b]	4.76±0.46[b]
45 Min	-	-
0 Min (Control)	1.09±0.23[c]	95.45±8.24[c]

* Within column means followed by similar letters are not significantly different by ANOVA (CRD) at 0.05 L.O.D

Discussion : Results indicated that ultrasound probably cause considerable stresses leading to initial hyper feeding activity followed by reduced feeding, egg deposition and longevity. Insect possesses microscopic stable gas bodies, which oscillates under the influence of

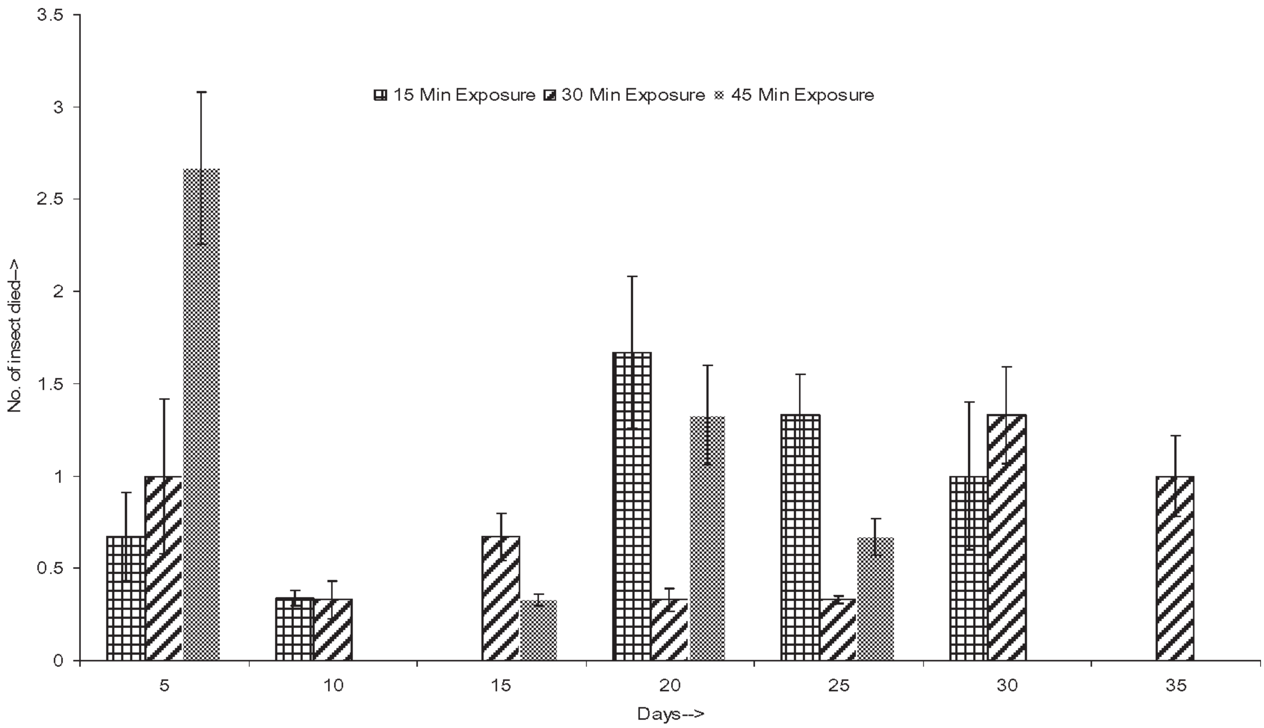

Fig. 2. Effect of ultrasound exposure duration on mortality of *H. theivora*. (bar indicate the Standard Error of Mean)

ultrasound[8]. This process may act as initial feeding stimulant. Regular disturbance of microscopic stable gas bodies of adult *H. theivora* might hinder normal feeding process. Consequence of ultrasound is the early death of insect which is evident from the fact that all insect exposed to ultrasound for 45 min, 30 min and 15 min died at 22.5 days, 33.5 days and 36.5 days respectively. However, when mortality at different time interval was considered, maximum mortality occurred at 45 min ultrasound exposure in first 5 days, indicating the severity of longer time of exposure (Fig. 2). In subsequent 5 days interval, the mortality decreased except one treatment. Neural adaptation to chronic noise is often observed among animal[9-10] and insects being a highly adaptive animal could not be excluded. The fact of decrease mortality in subsequent days might be due to adaptations of the bugs towards ultrasound. However, continuous exposure seems slowly killed the bugs but at decreasing rate. Use of ultrasounds in crop protection is not absolutely new, Belton[11] reported that ultrasound can protect corn from corn borer. Ultrasound can also be useful against storage grain pest viz. *Sitophilus granaries* adults inside wheat grain masses[12].

Number of egg/female/day of *H. theivora* decreased significantly with increase of ultrasound exposure time, which indicated that rate of egg laying adversely affected by the increase in exposure duration. Simultaneously, hatchability of eggs also followed the same trend. Similar effects were also observed by Huang and Subramanyam [13] in the case of another storage pest *Plodia interpunctella* which laid fewer eggs when exposed to ultrasound. Oviposition of cabbage looper, *Trichoplusia ni* was reduced by 41%, 23% and 30% when exposed to 20, 30 and 40 kHz sound, respectively[14]. Further, Kirkpatrick and Harein[15] noticed that hatching percentage of eggs of *Plodia interpunctella* reduced by 75% when the adult female was exposed to amplified low-frequency sounds (120-2000 Hz). Reduction in egg laying due to ultrasound exposures might be due to disruption in courtship and mating behavior[16]. Huang et al.[17] reported that ultrasound at 21-35 kHz could reduce the spermatophore transfer, larval numbers and larval weight of stored product insects like *Plodia interpuncttela*.

The present study showed that like other insects, ultrasound exposure affected feeding, longevity, and reproduction of *H. theivora*, which opens a new dimension in the application of ultrasound in insect pest management. However, being the first study of this kind on *H. theivora*, further works are necessary for optimizing protocol for field application and its implications as a component under the paradigm of IPM.

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