Monoterpenes of aromatic lemongrass (*Cymbopogon flexuosus*) and sweet basil (*Ocimum basilicum*) repel the bruchid beetle *Callosobruchus chinensis* (L.), a serious pest of stored legumes

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Pulse beetle (*Callosobruchus chinensis*) is a significant pest in tropical climates that affects stored legumes. Our objective was to study the repellent effect of the selected aromatic plant volatiles, namely *Azadirachta indica* (neem), *Mentha spicata* (spear mint), *Cymbopogon flexuosus* (lemongrass), *Ocimum basilicum* (sweet basil) and *Manihot esculenta* (tapioca) to pulse beetle, *C. chinensis*. Both single-, dual- and multiple-choice olfactometer assays to investigate the way *C. chinensis* reacts behaviourally to headspace volatiles revealed a significant repellent response to lemongrass and sweet basil headspace volatiles. Gas chromatography-mass spectrometry analysis revealed the presence of 42 and 50 volatile organic compounds in lemongrass and sweet basil respectively. Further, electrophysiological studies involving gas chromatography-electroantennographic detection (EAD)-revealed eight EAD active compounds each in lemongrass (4 nonanone, linalool, citronellal, β-citral, citral, β-elemene, *cis*-muurola-4(15), 5-diene and β-dihydroagarofuran) and sweet basil (linalool, estragole, 2-methyl-1-decanol, α-guaiene, allo aromadendrene, germacrene D, δ-guaiene and taucadinol). Of these, when the behavioural studies were performed on synthetic EAD active compounds, *C. chinensis* showed significant repulsion behaviour to monoterpenes, namely citronellal and linalool, indicating the potential of these compounds for the management of *C. chinensis*.

Keywords: Headspace volatiles, gas chromatography-electroantennography detection, gas chromatography-mass spectrophotometry, olfactometer assays, repellents.

Japan, Indonesia, Sri Lanka and Burma, is a serious pest of stored legumes[1,2]. The infestation of pulse beetle frequently starts in the field (primary infestation), where on the pods the female adult eggs will be released. The emerging grubs then penetrate the pods and stay hidden inside the seeds, resulting in secondary infestation that causes significant losses in the post-harvest period[3,4]. The pulse beetle damage in legumes causes a serious problem as they are a leading source of protein in the developing world[5].

Of different legumes, *Vigna radiate* (L.) Wilczek, often referred to as green gram or mungbean, is a significant pulse crop belonging to the family Fabaceae and the third most popular pulse crop throughout South Asia, including India[6]. This crop is grown in India, Pakistan, China, Myanmar, Bangladesh, Thailand, Philippines, Malaysia, Kenya, Malawi and United States[7]. It is an excellent source of protein, accounting for 25–28%, and other micronutrients[8,9]. Further soil health is improved by fixing nitrogen in the atmosphere through a symbiotic relationship with Rhizobium in the soil[10,11]. During pre- and post-harvest stages, a total of 65 insect species attack green gram. The pulse beetle alone accounts for 50% to 60% of damage in green gram[12] and can cause 100% damage during storage[13]. Researchers have carried out a number of studies on this issue of controlling the pulse beetle infestation[14,15]. Pulse beetle infestation is extensively controlled by the use of fumigants, but regular applications of fumigants have caused serious problems such as environmental pollution, residues in food and insecticide resistance[16,17]. In the recent past, research has focused ...