Biological characterization of the predominant strains of fall armyworm in India with regards to biocontrol agents and pheromone

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The invasion of fall armyworm (FAW) to the Eastern hemisphere poses a major challenge to the food security efforts of several nations including India. Invasive FAW population is primarily composed of two predominant strains differentiated based on the mitochondrial *cytochrome c oxidase* (COI) gene, known as COI-RS (hybrid strain) and COI-CS (corn strain). COI-RS, in particular was found to be different from the ancestral rice strain in America and displayed characteristics of typical inter-strain hybrid population. Although the ancestral populations have been tested for their mating behaviour and response toward pheromones and biocontrol agents, similar studies have not been performed on the invasive populations. We report here the inter-strain mating behaviour of COI-RS and COI-CS populations from India along with their susceptibilities towards different biocontrol agents. COI-RS larvae were more susceptible to *Spfr*NPV infection compared to COI-CS larvae. The response towards other biocontrol agents was similar in the two strains. Electroantennogram response study revealed that the two strains differed in their response towards FAW pheromone, where COI-CS males displayed higher mean antennal response towards Z-9-tetradecenyl acetate (87%), Z-11-hexadecenyl acetate (12.5%) and Z-7-dodecenyl acetate (0.5%) than COI-RS males. Similar to the ancestral population, we found unidirectional mating between COI-RS females and COI-CS males while the reverse cross did not yield viable offspring. However, further detailed studies are required to confirm this observation.

Keywords: Biocontrol, CO1-CS, CO1-RS, genetic strains, invasive fall armyworm, pheromones.

FALL ARMYWORM (FAW), *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) is one of the most notorious pests of maize in different parts of the world including India. It is known to attack more than 350 plant species belonging to 76 families such as Poaceae, Asteraceae and Fabaceae[1] causing serious damage to rice, sorghum, sugarcane and vegetables[2]. It was native to tropical and subtropical regions of America but has now spread to wider geographical locations. Fall armyworm was first reported outside America from Nigeria, Sao Tome, Benin and Togo in Africa in 2016 (ref. 3). It was first reported in India in 2018 from Karnataka[4] and soon spread to other Indian states such as Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Maharashtra, Odisha, Tamil Nadu, Telangana and West Bengal[2]. FAW was reported from Myanmar, China, Pakistan, Australia and United Arab Emirates[3]. The early whorl stage of maize crop is susceptible to FAW due to its high larval load[5]. As there is no diapause reported in this pest, overlapping generations are noticed in a cropping period[6]. The average cost on pesticides spent by farmers per 100 kg maize grain was US$ 0.124, US$ 2.04, US$1.68 and US$ 1.39 in 2017, 2018, 2019 and 2020 respectively[6].

Fall armyworm is genetically composed of two different strains called corn strain (CS) and rice strain (RS), which exhibit different host specificity[7]. The CS prefers maize, sorghum and cotton, whereas RS prefers rice and wild grasses[8]. Both strains of FAW are morphologically identical in larval and adult stages[9]. They differed in their host plant preference, seasonal abundance and mating behaviour where CS females were found to mate during the first two-thirds of scotophase, whereas rice females mated in the last one-third[10]. Both the strains also differed in their pheromone composition; CS females contained relatively higher amount of Z11-16:Ac (m) compound than RS females[11]. Both the strains also differed in their performances when reared on different hosts. The RS performed well and had higher survival rate and faster development when reared on bermudagrass than the CS[12]. The CS had less developmental period when reared on pinto bean diet than

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