Decoding the copulation and courtship patterns of an invasive pest, *Spodoptera frugiperda* (J. E. Smith, 1797) from India

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Experiments were conducted to study and document the copulation duration and effect of mating on the female calling behaviour of the Indian population of an invasive pest, *Spodoptera frugiperda* (J.E. Smith). Results showed that 58.39% of the females exhibited calling in the absence of males and 88.18% of females in the presence of males on the first scotophase. The onset time of calling was early in females when males were present. Calling length and calling bouts varied significantly with an increase in the age of virgin females, while in multiple-mated females, the trend was different. The copulation duration of *S. frugiperda* varied between 78.00 ± 7.35 min and 197.14 ± 11.06 min. The copulation duration and percentage of females mated were maximum in the second scotophase. The fecundity of multiple-mated females ranged between 841 and 1849 with a mean of 1176 ± 113 eggs per female, while in single-mated females, it ranged between 476 and 1368 with a mean of 878 ± 175 eggs per female. Our results indicated that the calling and mating took place in the first scotophase and were at a peak in the second scotophase. This information can be used in formulating biorational molecules, which can modulate calling behaviour and improve mating disruption in *S. frugiperda* for its management.

Keywords: Calling behaviour, copulation, fall armyworm, mating frequency, scotophase.

damage to maize, sorghum, cotton and soybean[8–10]. The extent of yield loss due to FAW was reported to be around 22% to 67% in Ghana and Zambia[11], and it incurred an annual loss of 4.1 to a massive 17.7 million tonnes (mt) in African countries[12]. In India, the FAW damage on maize was reported as 20–80% from July 2018 to February 2019 (ref. 13), which was estimated to reduce the total maize production by 37,000–75,000 tonnes[14]. In south India, FAW larvae have caused maximum damage to maize in the July and November months of the *kharif* and *rabi* seasons respectively[15]. A recent study from India reports that the cost of pesticides spent by farmers per 100 kg of maize grain during 2020 was US$ 1.39 (ref. 16). The capacity of long-distance migration of adults and increased globalization favoured FAW to invade new regions[17]. Furthermore, a high fecundity of more than 1000–1500 eggs and polyphagy might be the factors that have FAW colonization in a new area and severe crop damage[18].

The complex process of searching for a mate for copulation involves male and female moths communicating in complementary ways. The predominant communication mechanism of nocturnal species is the release of pheromones by females, termed as calling. These chemical cues are then subsequently sensed by males[19,20]. Sex pheromones are important communication messengers for mating. In attracting mates, pheromone emission during calling behaviour is a crucial stage and has drawn a lot of interest in the present scenario of pest management via semiochemical appro-