

## Short Communication

# Relations between air temperatures and mating behaviour of *Spodoptera litura* adults in nighttime in the tobacco field

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Because it was previously shown that nocturnal moth larval behavior is influenced by both circadian rhythms and climatic variables, we pursued to investigate the relations between air temperatures and mating behavior of *Spodoptera litura* adults. Nighttime recordings of adult movement showed a complex interaction between timing and temperature. We found maximum number of mating adults at 3:00 when the average nighttime temperatures were more than 14°C. However, when the average nighttime temperatures were less than 14°C in the tobacco field, peaks adult movement happened before 3:00. Altogether, these results suggest that the behaviors of *S. litura* adults are partly regulated by air temperatures during nighttime in the field, and this could be used to improve biological control methods against the *S. litura*.

**Key words:** Mating behavior, nocturnal moth, circadian rhythm, pheromone trapping, yellow sticky traps, crop pests, plant-herbivore interaction.

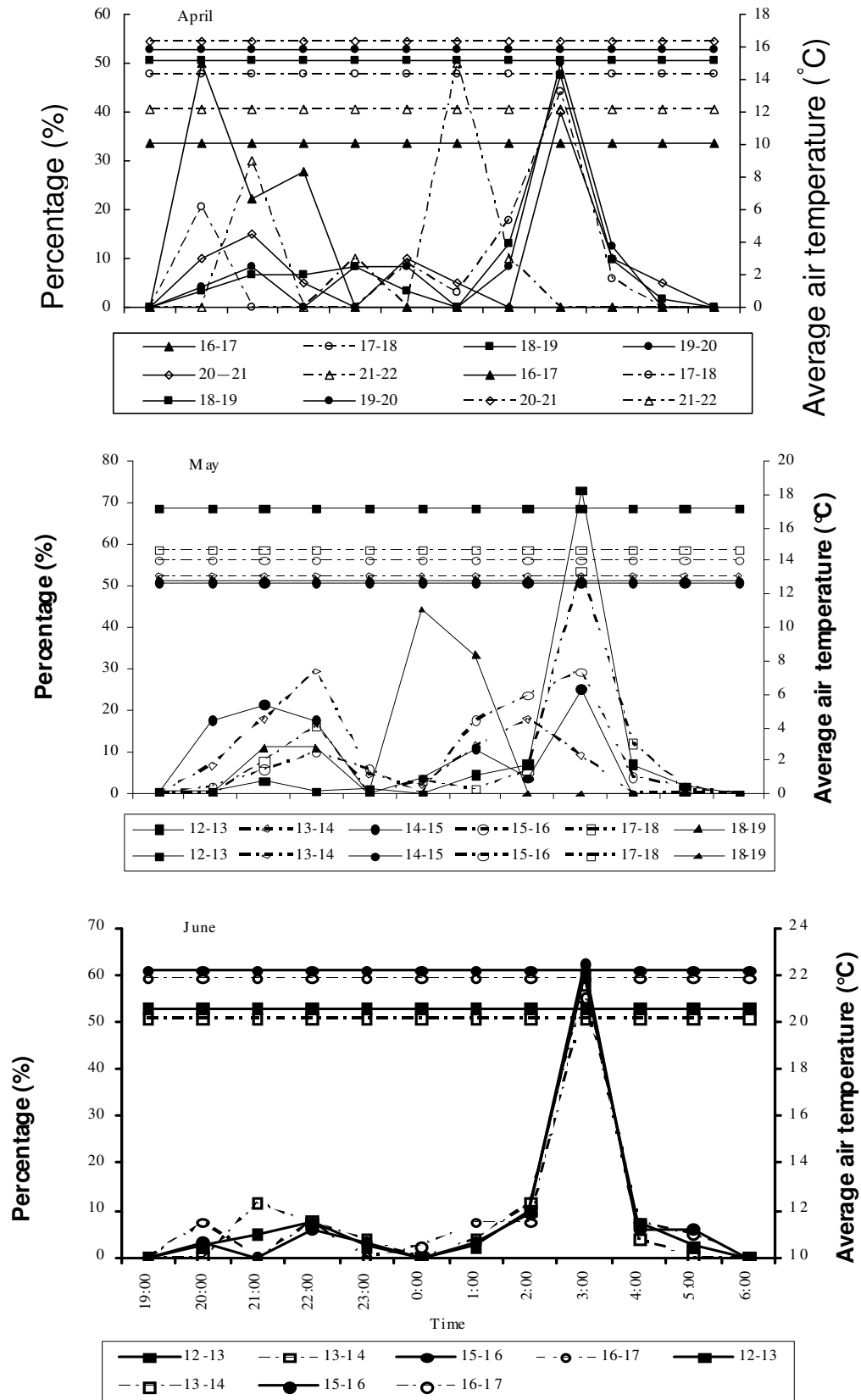
## INTRODUCTION

The oriental leaf worm moth - *Spodoptera litura* (Fabricius) - is an important insect pest on tobacco causing serious damage by defoliation ((Joshi et al., 1982; Zhou et al., 2006; Zhou et al. 2007). The biology and population dynamics of this pest had been extensively studied (Hassan et al., 1960; Patel et al., 1973; Parasuraman and Tayaraj, 1983; Garad et al., 1985; Osamu, 2000), pointing out a significant correlation between larval behaviour of *S. litura* and temperature or humidity (Parasuraman and Tayaraj, 1983). For instance, larvae preferred to move and feed at cool and moist

nights (Hassan et al., 1960; Parasuraman and Tayaraj, 1983), and 99% of the larvae were found feeding from 0:00 to 3:00 in cotton fields (Parasuraman and Tayaraj, 1983). Adults of the same species can mate right after emergence for 1 to 2 h, usually at night time (Parasuraman and Tayaraj, 1982). Thus, rates of adult emergence and subsequent mating seem to follow natural day and night cycles. For example, it has been shown that the number of emerging adults peaks between 21:00 and 22:00 h. in the fields (Hassan et al., 1960; Jarczyk and Herele, 1960; Parasuraman and Tayaraj, 1982).

In this experiment, emergence and possible mating behavior of *S. litura* adults was studied and correlated with night air temperature in the tobacco field. The findings of this experiment build on the hypothesis that air nighttime temperature plays an important role in mating

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**Figure 1.** Left Y-axis represents night hourly percentage capture of *S. litura* adults over three months (April, six days; May, six days; and June four days). Right y-axis represents average temperature per sampling night.

behavior of adults in the field.

## MATERIALS AND METHODS

The experiment was conducted in the tobacco field in the experimental farm of Nanxiong Research Institute of Tobacco, Nanxiong City, Guangdong Province, in South China in 2006. There were 300 ha of tobacco in the research farm. Two fields where this insect pest caused serious damage were used in the experiment. The acreages of the two experimental fields are more than 4000 m<sup>2</sup>. The distance between two experimental fields was 50 m. Two pheromone traps (TAKEDA Agricultural CO., LTD, Japan) were hanged (1.5 m high) in the middle of the two experimental fields, respectively. Our previous investigations, conducted in 2005, the three larval instars of *S. litura* were observed feeding on tobacco foliage from 3 April till early June. Subsequently, adults were observed flying from 15 April till end of June (unpublished data). Thus, this experiment, conducted in 2006, was divided into three collection efforts: 1) 16-22 April, 2) 12-19 May, and 3) 12-17 June. During each collection period, we recorded the number of adult males per traps for six days in April and May, and for four days in June hourly from 19:00 to 6:00 in nighttime in the tobacco field. Simultaneously, air temperature was also recorded.

## RESULTS AND DISCUSSIONS

We have here shown that adult behavior of *S. litura* changes with the climatic alteration of seasons in the field. The findings of our experiment revealed that the maximum number of mating adults varied with the changing of average temperatures at night in the tobacco field. In April, several peaks of mating adults were observed because of the fluctuation in the air nighttime temperatures. The peaks of mating adults were noticed at 1:00 and 3:00 when the average nighttime temperatures were 12-14°C and above 14°C in the tobacco field, respectively. However, the peak of mating adults happened at 20:00 - 21:00 when the average nighttime temperature was below 12°C in the tobacco field (Figure 1). Similar results were observed in May, with the maxima of adult captured at 3:00 as the average nighttime temperatures were always above 14°C (Figure 1). In June, nighttime temperature was always above 20°C, and again peak capture rates were observed at 3:00 in the tobacco field (Figure 1). Thus we conclude that adult emergence and movement is simultaneously controlled by both the circadian rhythms and temperature. The maximum number of mating adults occurred at 3:00 when the average nighttime temperatures were more than 14°C, but those happened before 3:00 when the average nighttime temperatures were less than 14°C in the tobacco field. The results suggest a strong relationship between occurrences of *S. litura* adults and the nighttime

temperatures in the field. This would be in accordance with similar findings on *S. litura* larvae (e.g. Hassan et al., 1960; Parasuraman and Tayaraj, 1983).

Previous studies indicated that the maximum number of mating adults occurred at 21:00-22:00 at night in the field (Hassan et al., 1960; Jarczyk and Herele, 1960; Parasuraman and Tayaraj, 1982). This is not in line with our results. Insects might use physical sensory organs to detect the microclimate of their habitat, and their behaviors changed with the altering microclimate of habitat in the field (Saunders, 1982). Our experiment reveals that the peak of mating *S. litura* adults occurs at 20:00-22:00 in early spring (April), but then shift later in the season with maximum observations occurring at 3:00 in summer in South China. We argue that this is partly driven by changed in average nighttime temperature, and possibly other abiotic and microclimatic conditions. The findings will be helpful to control of *S. litura* by interference techniques or biological control implementation in the future.

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