Thermal energy and artificial diet for tobacco caterpillar *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae) development

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ABSTRACT

Development and survival of tobacco caterpillar *Spodoptera litura* larvae and pupae were studied at each of seven constant temperatures, 15±1, 18±1, 21±1, 24±1, 27±1, 30±1 and 33±1°C, in incubators. Oviposition, incubation, larval and pupal periods were recorded at each of the temperatures. The survival from 1st instar to adult emergence ranged between a maximum of 60% at 24°C and 30% at each of 18°C and 33°C. Developmental duration of different larval instars and pupae declined with an increase in temperature from 15 to 33°C. The optimum temperature for larval and pupal survival in *S .litura* on artificial diet was observed to be 24°C. On the other hand, optimum temperature range for oviposition was observed to be 27-33°C.The relationship between temperature (T) and development rate (r) was establishedusing linear regression to estimate the thermal constant (K) and development threshold (T_0).Thermal constant for 1stto6thlarval instars were computed as 76.9, 90.9, 125, 83.3, 62.5, 90.9 and 200 degree days (DD), respectively, with corresponding development thresholds as 12.8, 11.7, 9.8, 10.3, 10, 10.9 and 13.2°C. Single developmental threshold for larval stage was computed as 13°C.These thermal constants and development thresholds can be used in developing mechanistic population simulation model, which in turn will facilitate the assessment of climate change impact on the pest.

Key words: Thermal energy, artificial diet, development rate, *Spodoptera litura,* survival

Tobacco caterpillar*, Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae) is a perilous insect pest affecting economically important crops such as tobacco (*Nicotiana tobacco* L.), castor (*Ricinuscommunis* L.), cotton (*Gossypium* sp. L.), soybean (*Glycinemax* L.) and groundnut (*Arachis hypogea* L.) throughout tropical and temperate Asia, Australasia and the Pacific Islands (EPPO, 2020). Out of 112 globally recorded host plants of *S. litura*, 60 are known only from India (CABI, 2020; Jha *et al*., 2016). Due to nocturnal habit, high mobility of adult moths and ability to oviposit on a wide range of host plants, *S. litura* has huge potential to invade new areas and to adapt to wide range of ecological situations (Duraimurugan, 2018). In India, *S. litura* is widespread in almost all the states and inflicts significant losses to economically important crops like soybean, cotton and groundnut. *S. litura* is likely to further increase under the imminent climate change, as it has been found to consume 30 per cent more cotton leaves at elevated CO_2 levels than ambient (Kranthi *et al*., 2009). Outbreaks of *S. litura* were also noticed in major sunflower growing areas of Central and Southern India. During 2005, the outbreak of *S. litura* led to more than 90 per cent defoliation of sunflower (Sujatha and Lakshminarayana, 2007).

Insects being poikilothermic organisms, the developmental rate is highly reliant on external temperature conditions. Hence, temperature is generally considered the single most significant environmental factor influencing behavior, distribution, development, survival and reproduction in insects (Bale *et al*., 2002). Knowledge on the temperature-dependent population growth potential of insect pests is highly imperative for understanding their population dynamics and implementing agro-eco region specific pest management strategies, especially in the context of predicted global climate warming (Kroschel *et al*., 2013). Considering this, the temperature rise of 2.7–4.7°C predicted due to potential climate change (IPCC, 2013) may have drastic consequences for future incidence of *S. litura.* The vast majority of studies that infer the effects of temperature on developmental biology of *S. litura* have been undertaken under only one constant temperature in laboratory (Roa *et al*., 1989; Prasad 2004; Bharathi *et al.,* 2007; Patil *et al*., 2014). A few studies that addressed the development of *S. litura* at a range of constant temperatures, were concerned with predicting developmental rates and threshold temperatures using linear degree day or heat summation models (Rao *et al*., 1989).The objective of this study was to develop thermal