UTILIZATION OF REMOTE SENSING AND POPULATION DYNAMICS FOR PREDICTING THE ANNUAL GENERATIONS OF COTTON LEAFWORM *Spodoptera littoralis* (Boisd.) (LEPIDOPTERA: NOCTUIDAE) UNDER CLIMATE CHANGE

By

AMIRA HASSAN AHMED MOURSEY

B.Sc. Agric. Sci. (Economic Entomology), Fac. Agric., Cairo Univ., 2008

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APPROVAL SHEET

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ABSTRACT

This study was conducted to study the effect of four constant temperatures 17, 22, 27 and 32 °C on the biology of cotton leafworm, *Spodoptera littoralis* and determine the threshold temperature and calculation of the thermal units for all stages in laboratory to determine the threshold temperature and the average number of degree days demanded for complete one generation then used both information for predicting annual generations of *S. littoralis* under field condition. Remote sensing was used as a new technology in calculation of the thermal units for pest to predict its annual generations

In laboratory study, the thresholds of development were 11.58, 6.44, 12.45, 10.69 and 9.76˚C for eggs, larvae, pupae, pre-oviposition period and generation, respectively, while the averages of their thermal units were 41.97, 329.18, 134.24, 25.04 and 511.4 dd's, respectively. A field study was conducted at Qaha farm, Qalyubiya Governorate, Egypt for two successive years (2010 & 2011) using sex pheromone traps. The data showed that *S. littoralis* had 7 annual generations in addition to overwintering generation. Results cleared that the mean deviations between the observed and expected generations were +2, +3, +3 +3, 0, +4,and +3 days with an average of +2.57 day at 2010 while it was +1, +1, 0, +1, -1, +2, and zero day with an average of +0.71 day at 2011 .

Finally, in this study remote sensing proved its accuracy in degree-days summation and in predicting times of infestation; thus helping for successful IPM programs.

Key words: NOAA satellite image, *Spodoptera littoralis* generations, Accumulate heat units, predicting pests.

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INTRODUCTION

The Egyptian cotton, *Gossypium barbadense* L., is considered a major economic crop in Egypt. The total cultivated area is decreased continuously; it reached in 2012 to 337.516 feddans (http://www.egyptcotton-catgo.org/). The governmental policy in Egypt is offering all facilities to encourage farmers to increase the production of cotton for both local production and exportation. Due to that the Egyptian cotton is able to be the first cash crop for the national income.

One of the major challenges facing the production of cotton yield is the damage effects caused by pests especially the Egyptian cotton leafworm *Spodoptera littoralis* (Boisd.) which is the major economic pest in Egypt. It is also considered as the major cotton destructive polyphagous lepidopterous insect pest which causes reduction in quantity and quality of the yield (Hosny, 1980 &Hosny *et al.*, 1986). In addition, larvae of this pest feed on about 40 plant families, many of which are of high economic importance (Khodaverdi *et al*., 2010).

Population parameters are important in the measurement of population growth capacity of species under specified conditions (Farahani *et al.*, 2011). In ecological study, life table is the most important analytical tool, which provides detailed information of population dynamics to generate simple but more informative statistics. The collection of data on life table at different temperatures give an important task for pest management in different environmental conditions (Ali and Rizvi, 2008).

Although chemical control are still the easy way to reduce the number of the pests, but on the other hand it has not provided a long-term solution for cotton pest problems because of high costs, environmental impact and related problems such as resistant of insect to insecticide, reduction of natural enemies of pests and the resurgence of secondary pests (Amin and Gergis, 2006). The early prediction of this pest population is essential for Integrated Pest Management (IPM) programme and helping farmers to avoid intensive use of pesticide and decrease the cost of control applications.

Prediction based on accumulation of degree days is considered a valuable tool for predicting the appearance of an insect when the crop is most likely to be damaged. However, for degree days to be used to make these predictions, researchers must determine the number of degree days necessary for the event to occur. That is called the thermal constant. The thermal constant, just like the threshold temperature, will differ for different insects. The degree days method can be used to predict insects when reach a particular stage of their life cycle if three things were known: the lower threshold temperature (t_0), the average daily maximum and minimum temperatures and a thermal constant.

Modern agriculture is influenced by both the pressure of increased productivity and increased stresses caused by plant pests. Geographical Information Systems (GIS) and Global Positioning Systems (GPS) are currently being used for variable rate application of pesticides, herbicide and fertilizers in precision agriculture applications but the comparatively lesser-used tools of remote sensing and spatial

analyses can be of additional value in integrated pest management practices. The tools provide valuable information in an integrated pest management context, allowing for a complete understanding (via remote mapping or spatial modeling) of the spatial complexity of the abiotic and biotic characteristics of a field and its crops, and providing information about pest populations that are present or likely to occur.

Many authors proved that Remote Sensing technologies can provide quicker responses than customary manual scouting methods for determining the presence of pests (Sharma, *et al.*, 1996; Snow, *et al*., 1997; Hassan and Onsi, 2004; Jainwen, *et al*., 2005 and Ramesh, *et al*., 2008).

We should throw the light about the study. It was a cooperation between Plant Protection Research Institute (PPRI), Agricultural Research Center (ARC), Ministry of Agriculture and land Reclamation, in collaboration with the National Authority for Remote Sensing and Space Science (NARSS).

Therefore the objectives of the current study are

1) Recognizing all biological aspects of the cotton leafworm, *S. littoralis* under constant temperature regimes and determining the baseline temperature (t_0) for different developmental stages and the thermal units required to complete the developmental stages of one complete generation.
2) Establish an integrated prediction from the life table parameters.

3) Ecological studies for monitoring and predicting the changes in the population dynamic and seasonal fluctuations according to the number of males attracted and captured by the sex pheromone traps.

4) Using new techniques for calculating accumulated heat units of *S. littoralis* based on remote sensing data.