Evaluation of the seasonal fluctuation of populations of the armyworm, *Spodoptera frugiperda* (J. E. Smith, 1797) (Lepidoptera: Noctuidae) and its natural enemies in maize crops in Togo

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ABSTRACT
*Objective***:** to evaluate the seasonal fluctuations of S. *frugiperda* and its natural enemies in maize farming in Togo.
Methodology and Results: It consisted in surveying fields in twenty-seven (27) prefectures during the period from October 2019 to November 2021. It consisted in surveying fields and collecting data such as egg, larva and pupa clusters, infestation rates and the main natural enemies encountered according to the FAO "W" method. Then, the collected data were reared in the laboratory for the emergence of potential natural enemies over two seasons.
Conclusions and application of findings: It was found that infestation rates; number of egg clusters and larvae; emergence rate and natural enemies of *S. frugiperda* varied not only according to the survey area, but also and especially according to the season. The infestation rates over the two seasons ranged from 62.55 to 32.55%. On average, the number of larvae was higher in the great season (0.87) compared to the short season (0.41). Meanwhile, the adults emergence ranged from 38.22 to 100.00%; therefore, there are many natural enemies obtained such as *Cotesia icipe*; *Campotelis* sp., *Trichogramma pretiosum*, *Winthemia trinitatis*, *Doru luteipes*, *Geocoris punctipes* and *Hexamermis* sp. candidate to control *S. frugiperda*. Additional experiments are however necessary to evaluate climatological aspects on the life table parameters of the main candidate natural enemies.
Keywords: maize, *S. frugiperda*, natural enemies, sustainable management, Togo.

INTRODUCTION

Maize (*Zea mays* L.) is the staple food in sub-Saharan Africa with an average annual area of 34 million hectares devoted to its production (Kostandini *et al.,* 2015). Average annual production is estimated at over 70 million tonnes and is a source of food and income for about 300 million people (Kostandini *et al.,* 2015). Maize plays a central role in the staple diet in sub-Saharan Africa and in particular Togo as is the case of rice or wheat in Asia (Macauley and Ramadjita, 2015). It is consumed by almost the entire population with varying preferences and socio-economic contexts. Despite its importance and the assets Togo has, maize grain yields are still low; 1.39t/ha against a potential of between 5-6t/ha (DSID, 2016). The maize farming system, combined with population growth and the FAW (Fall Army Worm) invasion of recent years, have resulted in an increasingly marked decline in production. The armyworm is the most devastating insect pest present in maize fields in sub-Saharan Africa (Sisay *et al.,* 2018). Faced with these various problems, much research has been conducted in Togo and has shown the effectiveness of certain chemicals including Emacot and neem oil in reducing the population dynamics of the pest. However, these chemicals have a financial impact that the subsistence farmer cannot afford (Kasongo *et al.,* 2013). It is therefore becoming imperative to determine *S. frugiperda* management techniques such as identification and enhancement of its natural enemies that will enable farmers to sustainably increase not only crop yields; but also and above all to increase their income in order to improve their standard of living. Successful management of pests by means of their natural enemies in general, and those of maize in particular, is based on mastery of their behaviour in their various ecosystems. This knowledge enables the production and release of natural enemies (parasites, parasitoids and predators) to be carried out later. It is to address this issue that this study was initiated. This study aims to develop a new control strategy for *S. frugiperda* by controlling its seasonal population fluctuations and its natural enemies on maize production in Togo. This study will broaden the range of biological control methods in a sustainable maize pest management option using its natural enemies.

MATERIALS AND METHODS

Experimental site: The study was carried out in 27 prefectures throughout Togo (Figure 1). Togo is a West African country located between 6°06N and 11°08N latitude and 0°09W and 1°49W longitude, with a population of 6,191,155; of which more than 60% (62.3%) live in rural areas (RGPH, 2010).