Is there a landscape effect on moth pest (H. armigera) abundance and infestation rate in cotton fields in North Benin?

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Is there a landscape effect on moth pest (*H. armigera*) abundance and infestation rate in cotton fields in North Benin?

Noelline Tsafack Menessong [1, 2, 3], **Philippe Menozzi** [1], **Thierry Brevault** [1], **Marc Deconchat** [3], **Annie Ouin** [2]

[1] *CIRAD, Centre UPR «Systèmes de Culture Annuels» CIRAD-Persyst TA B 102/02 Avenue Agropolis 34398 - Montpellier cedex 5.*

[2] *Université de Toulouse, INP-ENSAT, UMR DYNAFOR, Avenue de l'Agrobiopole. Bp 32607 Auzeville. 31326 Castanet Tolosan*

[3] *INRA, UMR DYNAFOR, chemin de borde rouge,Bp 52627, F- 31320 Castanet Tolosan Cedex France*

Abstract: *Helicoverpa armigera* (Hübner), a polyphagous moth, is the major cotton pest in Africa. Larvae feed on bolls, flowers and squares, seriously reducing yield. To reduce the use of insecticides and to improve the management of this cotton pest, there is a growing interest in reinforcing the landscape's suppressive properties. The aim of this study was to determine if moth abundance and larval infestation differs among landscapes with different composition (diversity of crops, proportion of bush) to test for a landscape effect on *Helicoverpa armigera* abundance during peak infestation. In five cotton fields in four landscapes differing in land cover (cotton, cotton+maize, cotton + tomatoes, cotton + bush), measurements of larval infestation were made four times from September 23th to October 18th 2011. Additionally, adult moth abundance was established using light trapping from September 24 to 1st November in the four landscapes plus one landscape without any cotton field in the area of the W National Park. Larval infestation was significantly higher in the fields previously cultivated with tomatoes. Results of light trapping of moths did not reveal differences among the landscapes except in the landscape in the W National Park where no moths were trapped. This finding suggests that cotton infestation by *Helicoverpa armigera* could be related to the proximity of market gardening. Subsequent analyses (analytical chemistry and molecular biology) are underway to investigate this hypothesis.

Key words: Pest management - Cotton - *Helicoverpa armigera* –Landscape

Introduction

The study of processes against pests moth is a constant concern. Pesticides have long helped to maintain pest insect below an economic threshold. However, adverse economic conditions such as in West African countries, environmental risks associated to pesticide use and the emergence of pesticide resistant populations, advocate for an urgent reduction of pesticides in agriculture.

Helicoverpa armigera is a major pest of cotton crops (Vaissayre and Cauquil, 2000). Although the use of pesticides in the cotton sector is well-framed, studies have shown peaks

of infestations of *Helicoverpa armigera* in mid-September, during the flowering of cotton, with an absence for the rest of the year (Nibouche 1994).

The present study was performed in order to evaluate the possible effect of a specific landscape composition on the abundance of *H.armigera* in cotton fields.

Material and methods

Studied landscapes

The studied landscapes are situated in North Benin, 15 Km around Angaradebou city (Figure 1). Four landscapes were chosen to present different composition: mainly cotton crops in large fields (Land. A), cotton and maize (Land. B), cotton crops on fields where tomatoes were cultivated the previous wet season (Land. C), cotton and bush (Land. D). In each of the four landscapes, five fields were selected (from 0.62 ha to 5.03 ha). Lastly, a landscape free of cotton was surveyed near the W Park (Land E) (Figure 2). Land cover in a 500 m buffer around each cotton field was recorded using a GIS (ArcGis9.0, ESRI).
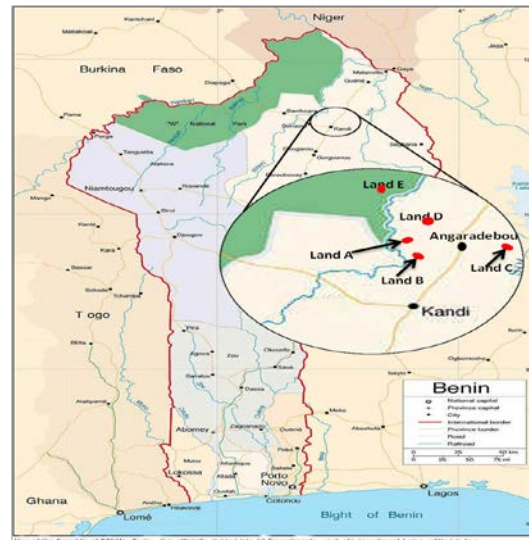

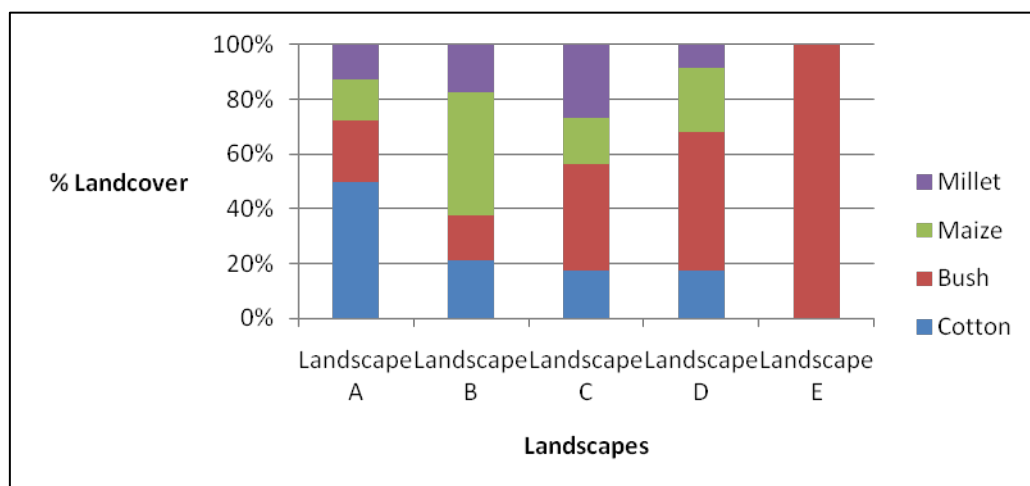Figure 1: The five studied landscapes, North Benin.

Figure 2: Landscape composition – land cover percentage in November 2011.

Two methods were used to evaluate *Helicoverpa armigera* abundance between 23 September 2011 and 1st November 2011. The first one is a direct measure of moth abundance by light-

trapping in the five landscapes. The second one is an indirect measure of cotton infestation by larvae in the monitored fields.

Moth abundance

In one cotton field per landscape per night, we trapped *Helicoverpa armigera* with light traps. Using mercury vapour lamps, the light trapping started at dusk and lasted two hours. At the end, for the 20 cotton fields, 38 nights trapping were done including 4 in Land E and 9 in landscapes A and C and 8 in landscapes B and D. Moths were preserved in 96% ethanol at ambient temperature for lab analysis. A *Kruskal-Wallis* test was run on the effect of landscape on moth abundance.

Cotton field's infestation

During one week, the five fields of one landscape were observed (one field per day), observations were made on 50 cotton plants, 25 per diagonal. On each plant, we observed and counted: i) the total number of boll versus number of pierced boll, ii) the total number of cotton flower versus number of pierced cotton flower, iii) the total number of bud versus number of pierced bud. To avoid edge effects, cotton plants at the edge were not taken into account. The measures of infestation lasted 4 weeks. At the end, for each of the 20 fields there were 4 measure of infestation. Statistical analyses consist on a GLM with, land cover 2010, percentage of maize, cotton, and bush as factors explaining infestation in the fields.

Results and discussion

Moth abundance in light traps

A total of 252 moths were trapped during the 38 nights trapping. More than 80% of moths were trapped between 12 October and 21 October 2011. No moths were trapped in the bush landscape (land. E). There was no significant difference in average moth abundance among the four other landscapes (KW=5.5002; df=3; p= 0.1386 (Figure 3).
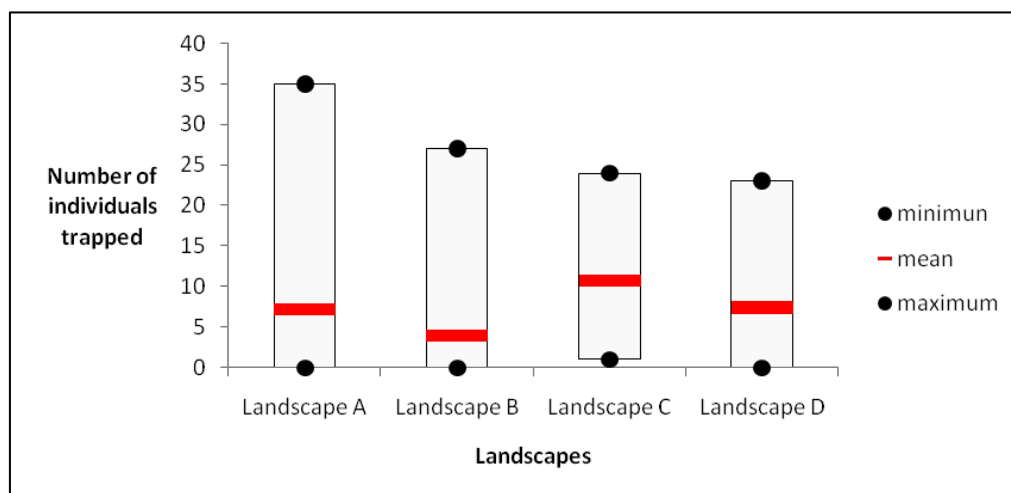

Figure 3: Mean, median and quartiles moths abundance in light traps in the four landscapes.

The absence of landscape effect on *H. armigera* moth abundance could be explained by i) the very low infestation rate recorded in all the cotton production region on year 2011 or ii) a massive arrival of migrants at cotton blooming time. Subsequent analyses, analytical chemistry and molecular biology would provide additional information to infer geographical origins of *H. armigera* in North Benin. The total absence of *H. armigera* in the bush landscape showed that there were no or very few individuals making their life cycle on wild plant such as cleome.

Larval infestation

The GLM analysis showed that previous land cover (land cover 2010) in the fields was the only significant variables explaining cotton field infestation (Table 1). Post Hoc test showed significantly higher infestation in cotton fields previously occupied by tomato crops (F=30.61, P<0.01).

Table 1: GLM results. Only major crops of the region are represented.

	F-Ratio	p-Value
Maize	1.12	0.31
Cotton	1.07	0.32
Bush	0.30	0.60
Landcover 2010	3.12	0.05

Tomatoes are one of the host plants of *H. armigera* but there is gap between the end of tomato crops and the peak of infestation in cotton fields. Landscapes where tomatoes were grown may be favourable for the maintenance of *H. armigera*. However, the question of the location of the pest during the dry season remains. Hypothesis of a possible long diapause in the soil was already tested (Nibouche, 1994) without positive results. *Helicoverpa* moths can not survive all the dry season waiting for wet season. The presence of some irrigated tomatoes fields near rivers could act as a refuge zone for the pest.

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