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Effect of the landscape complexity on biocontrol of the millet head miner, *Heliocheilus albipunctella* (de Joannis) (Lepidoptera: Noctuidae) in Senegal

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Introduction

Pearl millet (Pennisetum glaucum (L.) R. Br.) is one of the main cereal crops in Senegal representing about 60% of the total cereal production, with approximately 600.000 tonnes per year. Adapted to arid and semi-arid climates, millet production is mostly located in the peanut basin. The millet head miner (MHM), Heliocheilus albipunctella de Joannis (Lepidoptera: Noctuidae) is the major millet pest in West Africa, causing important yield losses up to 85% (Youm, Owusu, 1998). Despite years of research, control strategies developed through agricultural practices as deep ploughing or late planting have shown little success (Youm, Gilstrap, 1993). Recent studies on insect ecology have pointed out the importance of landscape-pest interactions as a crucial determinant of biocontrol success (Hunter, 2002). In Senegal, main natural enemies have been identified (Gahukar*, et al.*, 1986; Nwanze, Harris, 1992), but their natural habitats are still not well known. To better understand the environmental determinants of biocontrol of the MHM populations, we proposed a landscape approach focusing on the role of natural vegetation. We first used a very high spatial resolution of remote sensing data to map and to quantify the key landscape elements around a set of millet fields. A statistical analysis was then performed to identify environmental factors enhancing natural regulation of the MHM

The objective of this study is to investigate the effect of landscape complexity on biological control of the Millet Head Miner (MHM), *Heliocheilus albipunctella* (de Joannis) (Lepidoptera: Noctuidae) which is identified as the major insect pest in West Africa. This work was carried out in 2013 and 2014 around Dangalma village (14° 43’ 42’’ N, 16° 33’ 98’’ E), located in Djourbel region, Senegal.

Method

The quantification of biocontrol of *H.albipunctella* was measured using Biological control services index (BSI) developed by Woltz *et al.,* (2012), which was calculated on 45 millet fields separated at a distance of 2 km from each other. Covering a square region of 20*20 km, the habitat complexity was also measured yearly around each sampling sites using four landscape metrics assessment as pertinent for pest regulation. Calculated from two land cover maps generated from Pleiades satellite imagery, each landscape variables were evaluated at nine spatial scales ranging from 0.250 km to 2.250 km radii (at 0.250 km intervals) from the field center.

To study the effect of landscape attributes on BSI values a generalized linear model was performed. Finally, the best statistical model according to the Akaike Information Criterion (AICc) was used to identify the environmental key variables enhancing biological control of the millet head miner.

Results and Discussions

We found that BSI values increased with landscape complexity, measured as Shannon's Diversity Index (SHDI). Landscapes dominated by millet fields provides less biocontrol services to *H. albipunctella* than landscape dominated by natural vegetation. The study showed also that landscape diversity and composition at a scale of 1750 m surrounding the sampling sites explained the greatest proportion of the variation in biological control of this pest.

Conclusion and perspectives

This study indicates that natural vegetation and more specifically trees which are dominant in our study area have to be maintain to enhance biocontrol of *H.albipunctella*. Furthermore, it suggests that management to enhance landscape diversity has the potential to stabilize or increase biocontrol services. To improve this landscape management, we suggest to take into account the tree species and thus to better understand their key role as host habitat for natural enemies of this pest.

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