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# Influence of Some Cultural Practices on the abundance of three species of Syrphidae (Diptera) in Cotton systems in the Tchologo region in Northern Côte d'Ivoire

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## Abstract

There is a diversity of beneficial insects that help to regulate pest populations in cotton fields. Among these are species belonging to the family of Syrphidae play a role It is important because it feeds primarily on aphids in its larval stage and pollinators in its adult stage. The species *I. aegyptius and E. balteatus are examples. Syrphidae* and *S. scripta* were monitored to identify some cultural practices that influence their abundance. Surveys were conducted in cotton plots in four locations. The results showed that cultural practices such as tractor plowing, organic matter application, and average seeding density are strongly correlated with dimension 1. However, the application of small amounts of organic matter is strongly correlated with dimension 2. The studied cultural practices allowed us to understand their effects on the abundance of Syrphidae species at the plot level. The results obtained showed that the application of organic matter during plowing, average seeding density, and the previous crop promote Syrphidae abundance. Nevertheless, no effect related to the application of mineral fertilizers or different types of weeding was observed.

## Article Info

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## Keywords

Cotton, Syrphidae, abundance, cultivation practices

## Introduction

The overuse of synthetic pesticides in cotton crop protection in Côte d'Ivoire, combined with agricultural practices in a context of climate change and crop intensification, threatens the viability of the production system (Duhaime and Pinel, 2005; Koffi *et al*., 2018). Several research studies highlight the risks associated with the massive and excessive use of synthetic pesticides, particularly for human health and the environment (Liliana, 2007; Dorothée, 2011; Soro, 2022). Therefore, the search for alternative control methods to chemical control is essential. Several studies have demonstrated the indispensable role of beneficial insects in regulating pest populations on farms (Zoebelein, 1988; Stève and Robert, 2013; Soro *et al*., 2020). This is the case for hoverflies (Syrphidae), which are dipterans found in cotton fields, and whose larval and adult life cycles are well known. Some larvae are aphidophagous, others saprophagous, and still others mycophagous. As for the adults, they are mostly pollinophagous and nectarivorous . These characteristics make them valuable for agricultural production, both in their larval stage to control crop pests, primarily aphids, and in their adult stage as pollinators. However, certain key factors, such as cultivation practices, could play a

significant role in the abundance of hoverfly populations. For better management of the species present in cotton fields, it is essential to analyze the cultivation practices likely to influence their populations.

It is in this context that this study was been conducted to determine the climatic influence of farming practices on the abundance of populations of three Syrphidae species in cotton plots in northern Côte d'Ivoire.

## Materials and Methods

### Study area

The research was conducted in the cotton-growing region, specifically in the Tchologo administrative region (9° 35′ 00″ North, 5° 11′ 00″ West), located in northern Côte d'Ivoire (Figure 1). The climate is Sudanese, with two main seasons: a dry season from November to April, characterized by the harmattan wind, with peaks in December and February, and a rainy season from May to October, with peaks in August and September. Annual rainfall varies between 1,000 mm and 1,400 mm. The average annual temperature is 24°C, ranging from 12°C in December-January to 39°C in March-April (Coulibaly *et al*., 2016).

### Plant Material

The study was conducted on six varieties of *Gossypium cotton.* Hirsutum L. (Figure 2) popularized in rural areas.

### Animal Material

The animal material consists of three species of Syrphidae *Ischiodon aegyptius* (Wiedemann, 1830), *Episyrphus balteatus* (De Geer, 1776), *Sphaerophoria scripta* (Linnaeus, 1758). *Ischiodon aegyptius* (Wiedemann, 1830).

**Table.1** Study Area

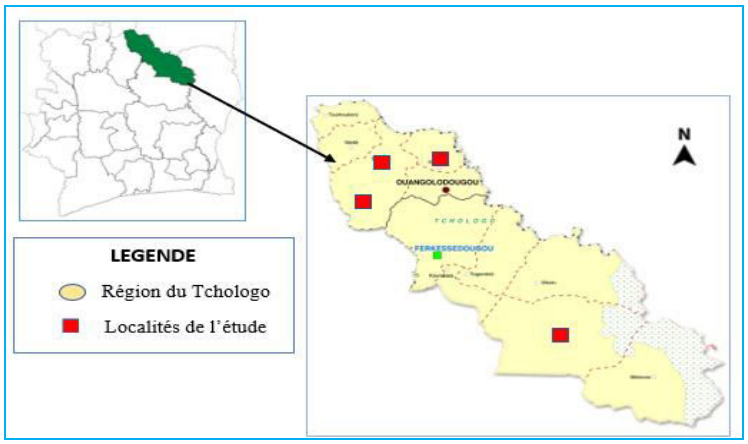
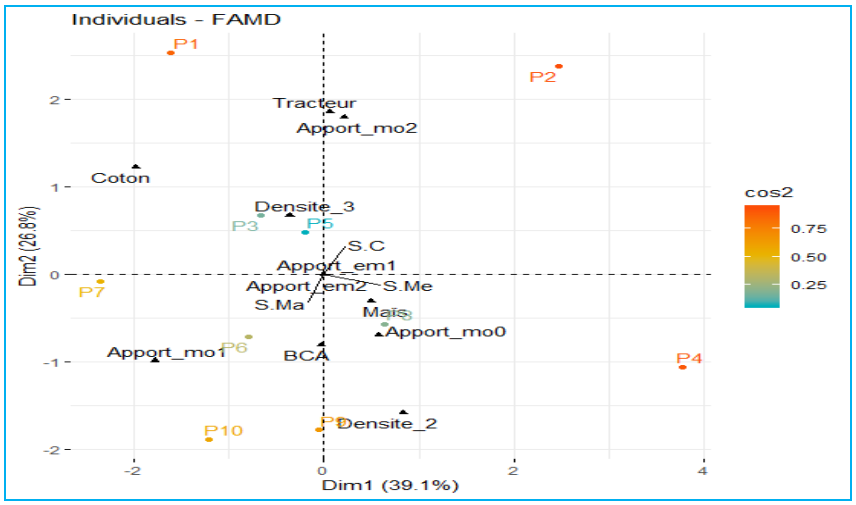



**Figure.2** Quality of representation of agricultural practices on the main axes of the factorial plane at Korokara.



### Data Collection on Farming Practices

Data on farming practices were collected through interviews with farmers. Farming practices such as the type of tillage, organic and mineral fertilization, seeding density, previous crop, and weeding method were recorded.

### Monitoring of Syrphidae populations

Four (4) cotton production zones were identified and forty (40) farmers' plots were selected, with ten (10) plots per zone, each with an area of 0.25 ha. These farmers' plots were distributed proportionally across the main planting decades in the region.

### Insect sampling

Collections were carried out using two methods: manual collection and trapping. For manual collection, a sweep net was used. Insects were collected every morning starting at 9:00 AM for two hours. Larvae were collected using entomological tweezers. For trapping, yellow plates filled with soapy water to two-thirds of their volume were used. The traps were checked weekly. Insects were collected from July to October 2023, from the larval to the adult stage. All samples were collected at least 10 meters from the field edges. (Soro, 2020). In total, sixteen (16) readings were taken from the 30th Day After Lifting (DAL), at regular intervals of one week, up to the 128th DAL.

The larvae were counted plant by plant, on a sample of 30 plants taken in groups of 5 consecutive plants per row, following the sequential method known as the "diagonal" method (Nibouche *et al.,* 2002).

### Data analysis

A descriptive analysis revealed the average densities of Syrphidae species in each location. To assess the influence of rainfall and temperature on Syrphidae species abundance, Pearson correlation tests were performed at each site using IBM-SPSS statistical software. The effect of agricultural practices on Syrphidae species abundance was studied using a factor analysis of mixed data (FAMD) with R 3.6.1 software.

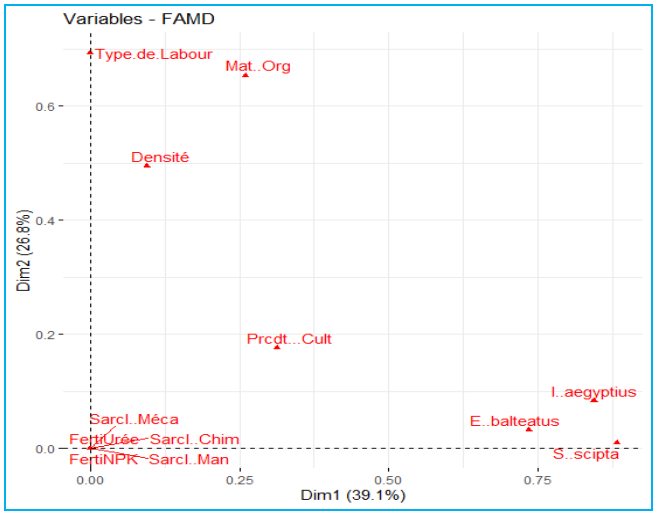
## Results and Discussion

### Influence of agricultural practices on the abundance of Syrphidae species populations

### Analysis of different agricultural practices

The statistical analysis performed on the qualitative variables from the surveys made it possible to represent the different practices in a factorial plane. Only the first two axes were retained, explaining 39.1% and 26% of the variability in the data, respectively (Figure 3). First, we observe that the ten plots are distributed relatively evenly along the two axes, reflecting a diversity in farmers' strategies. Cultivation practices such as tractor plowing, organic matter input, and average seeding density are extremely correlated with dimension 1. The same is true for the previous crop. However, the input of small quantities of organic matter is well correlated with dimension 2.

**Figure.3** Correlation between farming practices and the abundance of Syrphidae species in Korokara



### Effects of different agricultural practices on the abundance of Syrphidae species

To test the effect of farming practices on the abundance of Syrphidae species in the Korokara area, the results of the previously conducted practice analysis (Figure 3) were used. Correlations between quantitative and qualitative variables were represented on the first two axes (Figure 4), which together account for 65.9% of the information inertia. Among the different farming practices implemented at the plot level, only the first gradient of practices had an effect on the abundance of the three Syrphidae species, represented on axis 1 (39.1%) of the factorial plane ( *I. aegyptius* contributes 26.95%, *E. balteatus* 23.47%, and *S. scripta* 28.17%). The previous crop, the application of organic matter, and high cotton densities on the plots promote the abundance of the three Syrphidae species (Figure 5). However, agricultural practices such as plowing carried out with tractors or oxen for draft work have not had any effect on the abundance of Syrphidae.

This study highlighted the presence of Syrphidae species in cotton fields in the Sordi area. The presence of Syrphidae species in the fields is explained by the abundance of *Aphis aphids. gossypii which constitute the main prey of* hoverfly larvae ( Hazem, 2010; Thomas, 2012; Zitouni and Douar, 2017). According to Zoebelein (1955), the honeydew secreted by aphids acts as an attractant for adult hoverflies, thus reinforcing their presence in agroecosystems. These trophic interactions illustrate the importance of ecological balance in population dynamics (Pascal *et al*., 2008; Sauvion *et al*., 2013). The study results also showed that certain farming practices significantly influence the abundance of hoverfly species in cotton fields. Indeed, hoverfly species were most abundant in fields that received organic fertilizer during plowing. The use of organic matter enriches the soil with mineral elements and promotes the creation of a microclimate favorable to the reproduction of hoverfly species. These results are identical to those of Babin (2009), who showed that plots cultivated on soils richer in organic matter and with a more clayey texture were more favorable to mirids. However, the various statistical tests performed using factor analysis of the mixed data showed that there is no correlation between the mineral fertilizer used in the plots and the abundance of hoverfly species. The different statistical analyses carried out showed that tilling the soil does not significantly influence the abundance of hoverfly species. Indeed, the pupal stage of hoverfly species takes place on the leaves of vegetation surrounding cotton plots. These results are consistent with those obtained by Françoise *et al.* (2008) in the study on the effects of agriculture on biodiversity. Various research studies on the impact of tillage on insect fauna have shown that soil microfauna is strongly influenced. The significant presence of Syrphidae species in cotton fields could be a strategic opportunity to consider in an integrated pest management program for cotton. This integration would not only limit infestations of aphids such as *Aphis gossypii*, but also to stimulate ecosystem services such as pollination, thus contributing to crop productivity. From a sustainability perspective, increased use of beneficial insects like hoverflies could lead to a significant reduction in the use of synthetic chemical insecticides, while maintaining the ecological balance of the plots. These results could be part of a conservative biological control approach. Adapting farming practices to promote the presence and effectiveness of natural enemies could be a valuable tool to consider in an integrated pest management program. These results are similar to those of Fauteux (2023), who evaluated the effectiveness of *Eupeodes americanus* in a reservoir plant system in a greenhouse.

In conclusion, this study aimed to analyze the influence of certain cultivation practices on the abundance of Syrphidae species in cotton fields in the Tchologo region. Some cultivation practices, such as the application of organic fertilizer, planting density, and previous crops like maize and peanuts, are examples of these practices. which promote the presence of hoverflies in cotton fields. Given the very important role that hoverflies play in controlling cotton pests and their role as pollinators, it would be important to consider this beneficial insect fauna in biological control programs against cotton pests.

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