v. 4, n. 2, 2024

Journal of Agricultural Sciences Research

# ENTOMOFAUNA ASSOCIATED WITH ITALIAN PUMPKIN CULTIVATION "*CUCURBITA PEPO/ GRAY ZUCCHINI*" UNDER AGROECOLOGICAL SYSTEM IN CAMPECHE, MEXICO

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**Abstract:** This study focuses on the entomofauna associated with the cultivation of Zucchini Gray squash in agroecological systems in Campeche, Mexico. The research reveals the relevance of various insects, both beneficial and harmful, in the dynamics of this agricultural ecosystem. Earwigs and bees were identified as crucial elements for the biological control of agricultural pests, playing a prominent role in the natural regulation of harmful populations such as aphids, scales and mites. These findings support the notion that the diversity and activity of beneficial insects are essential for integrated pest management in sustainable agricultural systems. However, the presence of insect pests was also evident, such as thrips, laminated-legged bugs and aphids, representing potential threats to crops. These pest insects can cause significant damage, from lesions on the leaf blade to the transmission of viruses and toxins that weaken crops. The transfer of scientific knowledge to the agricultural community, environmental authorities and specialized scientists is essential for the effective implementation of sustainable agricultural practices. This approach not only contributes to improving agricultural management through informed practices, but also promotes the conservation of biodiversity and the resilience of agroecosystems. The Zucchini Gray pumpkin, an important part of the cucurbit family, plays a prominent role in human and animal nutrition due to its rich nutritional contribution. Despite facing challenges due to the presence of entomofauna in tropical and subtropical areas, its cultivation remains essential for food security and the local economy in Campeche, Mexico.

**Keywords:** Insects associated with cucurvitaceae, good agroecological practices.

## INTRODUCTION

The entomofauna associated with the cultivation of Zucchini Gray squash in agroecological systems in Campeche, Mexico, plays a fundamental role in the biological balance and health of the agricultural ecosystem. The choice of agroecological practices in the production of this crop not only seeks to maximize productivity, but also preserve biodiversity and minimize negative environmental impacts.

In this context, the entomofauna, made up of a varied set of insects, performs essential functions in pollination, pest control and the decomposition of organic matter, directly contributing to the sustainability of the agricultural system. Zucchini Gray squash, as a crop itself, presents a series of specific interactions with beneficial and harmful insects that shape the dynamics of the agricultural ecosystem.

In this framework, it is imperative to understand the diversity and ecological role of the entomofauna in the agroecological systems of Zucchini Gray pumpkin cultivation in Campeche. This study will not only provide crucial insights to optimize agricultural practices, but will also encourage biodiversity conservation and promote the resilience of agroecosystems in the region.

The Cucurbitaceae family, with a high number of species, plays a predominant role in human and animal nutrition due to its rich nutritional contribution (Lira-Saade, 995).

Characterized by a short vegetative period that results in rapid profitability, these plants address agricultural and nutritional problems Enciso-Garay et al., 2023). Their nutritional content, rich in provitamin A, vitamin C, potassium and magnesium, positions them as resources valuable (Cárdenas, 2012; Rodríguez et al., 2018). Horticultural production in 2022 in Mexico has experienced a significant increase, with 13,293,071.51 hectares

cultivated, highlighting 25,797.58 hectares destined for zucchini (Aguilar-Carpio, 2022).

However, the Italian pumpkin (Cucúrbita pepo) and other horticultural species of economic importance are affected in their growth, development, fruit setting and harvest by the presence of entomofauna in tropical and subtropical areas globally (Adja et., al. 2014). These insects, housed in the surrounding vegetation during their biological cycle, exert a detrimental influence on most horticultural species, being attracted to them as preferential hosts. Throughout their different phases of development, insects cause damage to various plant organs, compromising their internal metabolism. The presence of entomofauna is essential to implement good agroecological practices that effectively manage phytosanitary.

Likewise, the importance of identifying pollinating and beneficial insects, contributing to the maintenance of a biological balance during the crop cycle and counteracting the proliferation of insect pests (Romello, 2021). The damage caused by the latter generates considerable economic losses in the rural sector worldwide, not only reducing agricultural production but also affecting the quality of crops. The FAO, since 2020, has warned of losses of up to 40% of global agricultural production due to pests, with significant implications for the rural sector. Coinciding with the FAO, insect pests in plant species generate global annual losses estimated at 220 billion dollars, negatively impacting food security, agricultural marketing and the situation of vulnerable populations. With a diversity that exceeds 10,000 species worldwide, phytophagous insects reduce the yield and quality of plants (Agroasemex, 2019).

The zucchini (Cucurbita pepo L.), highlighted for its agricultural and social relevance in Mexico, shows significant figures in terms of cultivation and production. In 2019, 30,000 hectares were cultivated, generating a production of 615,000 tons of fruit with an average profit of 20.4 tons per hectare (SIAP, 2019). Mexico, ranked as the sixth largest producer in the world, contributes 2.6% of global zucchini production. Of the total produced, 84% is destined for export, mainly to the United States, Japan and Canada (SIAP, 2019).

Horticultural activity in Mexico constitutes an essential component of the national economy, playing a crucial role in generating employment and promoting economic development. During the year 2022, an extensive area of 13,293,071.51 hectares has been planted, with 25,797.58 hectares specifically dedicated to the cultivation of zucchini (Aguilar-Carpio, 2022). However, the Italian pumpkin (Cucúrbita pepo) and other horticultural species of economic relevance face challenges in their growth, development, fruit setting and harvest due to the presence of entomofauna in tropical and subtropical areas at a national and international level. These insects, many of which establish themselves in the surrounding vegetation during their biological cycle, negatively affect the health of plants.

The entomofauna shows a marked preference for horticultural species as hosts, causing significant damage to different plant organs and affecting their internal metabolism. The objective of the present study is to investigate the diversity, composition and functionality of the entomofauna associated with the cultivation of Italian Zucchini Gray pumpkin, specifically in the context of an agroecological system during the agricultural cycle (Summer-Fall) in the productive area of the Instituto Tecnológico Superior from Calkiní in the state of Campeche, Mexico. The aim is to understand the interactions between the entomofauna and the crop, such

as pollination, pest control and the general health of the agroecosystem. Furthermore, it aims to identify and highlight the importance of beneficial insects in promoting sustainable agricultural practices, thus contributing to the conservation of biodiversity and improving the resilience of the agricultural system in the region. The main purpose of this study is to provide relevant information for the design and implementation of integrated pest management strategies in agroecological systems that favor the harmonious coexistence between agricultural activity and local biodiversity.

## MATERIALS AND METHODS

### STUDY AREA

A representative area of Italian Zucchini Gray pumpkin cultivation was selected that is characterized by its agroecological system in the experimental plot of the Calkiní Technological Institute in the state of Campeche (ITESCAM) located in the province of Calkiní, Campeche Mexico. It has a warm subhumid climate with average temperatures of 27°C at 17 meters above sea level.

### GENETIC MATERIAL

Chabela F1 hybrid variety from Harris Moran Seed Company [MR]

### ENTOMOFAUNA SAMPLING

Systematic sampling was carried out at different phenological stages of the crop, collecting samples of insects present on the pumpkin plants and their immediate environment. Light traps and sticky traps were used to capture flying and crawling insects respectively.

Regarding the evaluation methods, it focused on the evaluation of pest insects associated with Italian squash (Cucúrbita pepo), using direct and indirect capture techniques. The direct collection method was based on the active and directed search for pest insects on the Italian pumpkin plants present in the plot. On the other hand, the indirect method consisted of the use of static chromatic traps strategically located at different points of each crop plot.

During the Italian pumpkin cultivation cycle, systematic sampling was carried out every second day, covering three time intervals: in the morning from 7 to 9 am, in the afternoon from 1 to 3 pm and in the evening from 5 to 6.30 p.m. Each captured insect was placed in specific containers for treatment and subsequently transferred to a lethal chamber for further analysis.

## RESULTS AND DISCUSSION

The dissemination of the results of scientific studies is essential for the practical application of knowledge in the agricultural field. Sharing detailed reports with the agricultural community, environmental authorities and specialized scientists allows the integration of evidence-based sustainable practices. This is consistent with literature that highlights the importance of scientific knowledge transfer to improve decision-making in agriculture (Pretty et al., 2009).

The active participation of the local agricultural community facilitates the implementation of practices adapted to local conditions (Tume et al., 2019). Furthermore, collaboration with environmental authorities can foster policies that support the conservation of agricultural biodiversity and the promotion of agroecological systems (Altieri, 1995). Direct communication with specialized scientists ensures expert feedback and can generate new areas of research (Kates et al., 2001).

In conclusion, the wide dissemination of the results contributes not only to the

practical application of the findings, but also to the continuous development of sustainable agricultural strategies and the construction of collective knowledge in favor of agricultural sustainability.

The results obtained are presented in detailed reports and will be shared with the local agricultural community of Campeche, environmental authorities and scientists interested in sustainable agricultural practices. It is crucial to share the results obtained in detailed reports with various actors, including the local agricultural community of Campeche, environmental authorities and scientists specialized in sustainable agricultural practices. This dissemination of information is justified for several significant reasons:

## IMPROVEMENT OF AGRICULTURAL MANAGEMENT

The delivery of results to the local agricultural community is essential to improve agricultural management, allowing the implementation of more sustainable and efficient practices in Zucchini Gray pumpkin crops. This evidence-based approach promotes the adaptation of cultivation methods to specific interactions between entomofauna and the crop, contributing to agricultural efficiency and productivity (Altieri, 1995).

By providing farmers with detailed information, the ability to make informed decisions is strengthened, highlighting the importance of scientific knowledge transfer in sustainable agriculture (Pretty et al., 2009).

## BIODIVERSITY CONSERVATION

The detailed dissemination of information on entomofauna highlights its fundamental role in the biodiversity of agroecological systems, raising awareness among environmental authorities about the importance of conservation. This evidence-based approach can support the formulation of policies and strategies that encourage the preservation of beneficial insects, essential for the ecological balance and health of the agroecosystem (Altieri, 1995). The literature supports the idea that biodiversity conservation in agriculture is crucial to maintaining the resilience of agricultural ecosystems (Pretty et al., 2009).

## DEVELOPMENT OF INTEGRATED PEST MANAGEMENT STRATEGIES

The information derived from this study provides a solid basis for the development of integrated pest management strategies in the Zucchini Gray pumpkin crop in Campeche. These results allow scientists and specialists in sustainable agriculture to design specific strategies that favor the conservation of pollinators, the promotion of predatory insects and the reduction of the use of pesticides, crucial aspects for the health of the agroecosystem (Altieri, 1995). Literature supports the importance of addressing integrated pest management to ensure sustainable and effective agricultural practices (Van Lenteren, 2012).

## PROMOTION OF SCIENTIFIC RESEARCH

The dissemination of results to the scientific community plays a fundamental role in advancing knowledge about the interactions between entomofauna and the cultivation of Zucchini Gray pumpkin in agroecological systems. This exchange of information encourages future research and collaboration, stimulating the progress of scientific understanding in the field of sustainable agriculture.

The literature supports the idea that collaboration among scientists and dissemination of findings are essential for the continued evolution of evidence-based

agricultural practices (Kates et al., 2001). Furthermore, active participation in the scientific community can generate new areas of research and innovative approaches to address challenges in sustainable agriculture.

### LONG TERM SUSTAINABILITY

The implementation of sustainable agricultural practices, based on the results of this study, emerges as a key strategy for the long-term sustainability of agriculture in the region. This approach not only benefits local farmers by preserving soil health and ensuring healthy crops, but also promotes the resilience of agricultural ecosystems in the face of environmental challenges (Pretty et al., 2006). The literature highlights the importance of agricultural sustainability to ensure food security and the conservation of natural resources (Foley et al., 2011).

In summary, sharing the results with the local agricultural community, environmental authorities and scientists is essential to translate research findings into concrete actions that promote sustainability and harmony between agricultural activity and biodiversity in Campeche, Mexico.

In this study, the fundamental presence of beneficial insects for the biological control of pests and balance in agroecosystems was evident. The identification of earwigs and bees as predators of agricultural pests, encompassing aphids, scales and mites (Table 1), highlights their crucial role in the natural regulation of pest populations. These findings support the thesis that the diversity and activity of beneficial insects are essential elements for integrated pest management in sustainable agricultural systems (Altieri, 1999). The presence and effectiveness of these beneficial insects underline the importance of conserving and promoting biodiversity in agricultural environments. In this study, the diverse presence of insect pests was evident, such as thrips, laminated-legged bugs, aphids, whiteflies, turtles, moths, hairy worms, ants and red spiders, representing multiple potential threats to crops. The identification of these pest insects highlights their ability to cause significant damage, ranging from lesions on the leaf blade to fruit deformation and transmission of viruses and toxins that weaken crops.

These results are consistent with previous research, such as that of Armstrong (2012), which also highlights the importance of understanding and addressing the threats of insect pests in agriculture.

## CONCLUSIONS

In conclusion, this study reveals the complexity of the interactions between the entomofauna and the cultivation of Zucchini Gray squash in agroecological systems of Campeche, Mexico. The presence of beneficial insects, such as earwigs and bees, highlights their fundamental role in the biological control of pests and the promotion of an ecological balance in agroecosystems. The diversity and abundance of these beneficial insects offer valuable information for the development of integrated pest management strategies, including the conservation of pollinators and the reduction of pesticide use.

On the other hand, the identification of insect pests, such as thrips, laminated-legged bugs, aphids and moths, highlights the multiple threats to which Zucchini Gray squash crops are exposed. The presence of these pest insects can cause significant damage, from lesions on the leaf blade to the transmission of viruses and toxins that weaken crops, affecting their yield and survival. Detailed understanding of these threats provides an essential basis for the design of management strategies that mitigate their negative impacts.

The transfer of the results to the local agricultural community, environmental

| Beneficial Insects | Benefits | Pest Insects | Damages |
|---|---|---|---|
| Earwigs (*Dermaptera*) | Predators of agricultural pests such as aphids, scales and mites. | Trips (*Thrips palmi Karny)* | Lesions on the leaf blade, flower and fruit. |
| Bees (*Apis mellifera y Melipona beecheii)* | Vespids are natural enemies of agricultural pests, mainly Lepidoptera larvae. | Laminated-footed bug (*leptoglossus zonatus)* | The nymphs and adults feed on fruits of various crops, causing them to fall and deform. |
| | | Aphids (*Aphididae)* | Aphids can transmit viruses from one plant to another causing viral diseases that reduce their yields and even cause the death of the crop. |
| | | White fly (Bemisia tabaco) | Adults and nymphs feed by sucking plant sap, while transmitting viruses and toxins that weaken crops. |
| | | Diaphania (*Diaphania nitidalis*) | Initially they attack tender leaves and flowers, then they pierce the fruits, destroying them internally, although they can also attack stems, flowers and fruits. |
| | | Turtles, cows *(Diabrotica speciosa)* | Adults feed on foliage and flowers; They can transmit Erwinia, which causes bacterial wilt. |
| | | Hairy worm (*Estigmene acrea)* | It feeds on the pods, leaves and flowers, its involvement is sporadic and localized. |
| | | Ants (*Atta y Acromyrmex)* | It affects the defoliation of cutter ants, an activity that affects the growth rate and survival of many crops. |
| | | Red spider (*Tetranychus urticae)* | They feed on the leaf blade causing chlorosis (yellowing) in sectors. |

Table 1 Beneficial and harmful insects in the cultivation of Italian pumpkin.

Own Preparation

authorities and specialized scientists is revealed as a key step for the effective implementation of sustainable agricultural practices. This approach not only improves agricultural management, but also contributes to the conservation of biodiversity, promoting the resilience of agricultural ecosystems in the region. The integration of sustainable practices, supported by the scientific knowledge generated in this study, stands as an essential strategy for the long-term sustainability of agriculture in Campeche, Mexico.

Together, these findings underscore the importance of considering the complexity of interactions between entomofauna and the Zucchini Gray squash crop in an agroecological context. The implementation of evidence-based strategies that promote harmonious coexistence between agricultural activity and local biodiversity is presented as a promising approach to optimize agricultural productivity sustainably in the region.

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