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ORIGINAL

Training plan for the conservation and implementation of coccinellids (Coleoptera: Coccinellidae) as natural biological control agents.

Plan de capacitación para la conservación e implementación de coccinélidos (Coleoptera: Coccinellidae) como agentes de control biológico natura.

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ABSTRACT

The problem is reflected in the degradation and loss of biodiversity of the agroecosystems of Theobroma cacao crops in Caquetá due to agrochemicals that abruptly alter the organisms that inhabit it, essential for the health of the ecosystem, according to Rachel (1962) "Is it reasonable to assume that we can apply a wide range of insecticides to kill a crop-destroying insect, for example, without also destroying the 'good' ones, whose function may be essential in the transformation of organic matter?" (p.62). A cocoa producer from the department of Caquetá was taught about the identification, conservation, and implementation of coccinellids (Coleoptera: Coccinellidae) as natural biological control agents in Theobroma cacao plantations (Malvaceae). For this purpose, an interview was conducted to assess the previous knowledge about insects associated with cocoa cultivation and how the farmer Hernando Susunaga handles them. It was found that the farmer has basic knowledge of the insects on his farm, both pests and beneficial insects, and that he uses commercial management (agrochemicals), but this generates additional expenses, which is why he is very interested in learning about biological control. Farmers are aware of the need for an agroecological alternative in the management of diseases and pests, but the little information they have prevents this from being possible and they resort to the usual method, which is to apply agrochemicals for a quick and "effective" solution.

Keywords: Biological Control; Pest; Effectiveness; Agrochemical; Alternative.

RESUMEN

La problemática se ve reflejada en la degradación y pérdida de la biodiversidad de los agroecosistemas de cultivos de Theobroma cacao en el Caquetá debido a los agroquímicos que alteran de manera brusca los organismos que habitan en el, esenciales para la salud del ecosistema, según Rachel (1962) «¿Es razonable suponer que podemos aplicar una amplia gama de insecticidas para matar a un insecto destructor de cosechas, por ejemplo, sin destruir también los ‹buenos›, cuya función puede ser esencial en la transformación de materias orgánicas?» (p.62). Se le enseñó a un productor cacaotero del departamento del Caquetá sobre la identificación, conservación e implementación de coccinélidos (Coleoptera: Coccinellidae) como agentes de control biológico natural en plantaciones de Theobroma cacao (Malvaceae). Para ello se realizó una entrevista para evaluar los conocimientos previos sobre los insectos asociados al cultivo de cacao y que manejo le da el agricultor Hernando Susunaga, se encontró que el agricultor tiene conocimientos básicos de los insectos de su predio tanto plagas como beneficiosos y le da un manejo comercial (agroquímicos) pero esto le genera un gasto adicional por lo cual está muy interesado en aprender sobre el control biológico. Los agricultores están conscientes de la necesidad de una alternativa agroecológica en el manejo de enfermedades y plagas, pero la poca información que tienen, evita que esto sea posible y acudan a lo habitual que es aplicar agroquímicos para una solución rápida y "efectiva".

Palabras clave: Control Biológico; Plaga; Efectividad; Agroquímico; Alternativa.

INTRODUCTION

Cocoa (Theobroma cacao) is a particularly vulnerable crop in tropical regions such as the Department of Caquetá in Colombia. It is significantly affected by pests, mainly mites or bedbugs, which cause crop losses and quality problems. Chemical pesticides have raised environmental and public health concerns, prompting the search for sustainable pest control methods. In this context, biological control involving natural organisms is considered a promising option.

Biological pest control uses natural predators and microorganisms to manage pest populations. This practice has been known for millennia, with examples of its use in ancient China during the third century. However, it was at the end of the 19th century that it began to attract significant interest, especially after the success obtained by introducing the ladybird Rodolia cardinalis (Coleoptera: Coccinellidae) to combat the flat bark louse Icerya purchase (Homoptera: Coccidae).

Ladybirds of the Coccinellidae family control agricultural pests such as aphids and scale insects that damage cocoa. Insects are agroecosystems that must be identified, conserved, and managed. Local producers are not adequately educated about the importance and application of ladybirds in sustainable agriculture.

To establish a training program for farmers in the Caquetá department that focuses on identifying, preserving, and controlling ladybugs as biological agents of natural biological control. The program aims to increase cocoa yields and promote environmentally friendly agricultural practices while promoting the sustainability of the crop in the region. It is based on the idea that it is important to provide farmers with knowledge and tools to change their agricultural practices, help preserve biodiversity, and protect the health of our ecosystem.

The problem of degradation and loss of soil biodiversity due to chemical fertilizers is manifested in the alteration of the organisms that inhabit the soil, essential for the health of the ecosystem; according to [(1)] " Is it reasonable to assume that we can apply a wide range of insecticides to kill the larval nests of a crop-destroying insect, for example, without also destroying the 'good guys,' whose role may be essential in the transformation of organic matter?" (p.62).

Biological insect control is fundamental for sustainable agriculture, as it allows the regulation of pest populations using natural enemies, which contributes to the health of the ecosystem and the reduction of chemical pesticides. According to [(2)] "biological control is considered a fundamental and indispensable part of any sustainable agriculture strategy with an agroecological basis" (p. 18). This highlights their relevance in pest management and promoting more environmentally friendly agricultural practices. Coccinellidae are entomophagous insects used for quite effective biological control. For example, a classic case of beneficial use of Coccinellidae is Rodolia cardinalis, used as a biological control to combat the cottony cushion scale insect Icerya purchase (Hemiptera: Margarodidae) in citrus fruits [(3)] basically the Coccinnellidae feed on insects of the genus Hemiptera, the main pests in cocoa crops so that they will be implemented as applied biological control, there are two meanings of "biological control": 1) the introduction of natural enemies by humans and their management to control pests, which they call applied biological control, and 2) spontaneous control in nature, without human intervention, which they call natural biological control.[(2)]

What knowledge do farmers need to acquire to effectively use ladybirds as biological control agents in their crops, and how can a training plan be structured to meet these needs?

Cocoa producers should be trained in the identification, conservation, and implementation of ladybirds (Coleoptera: Coccinellidae) as natural biological control agents in Theobroma cacao (Malvaceae) - cocoa plantations in the department of Caquetá, Colombia.

METHOD

A semi-structured interview was conducted with the farmer and some researchers in biological control to gain a deeper understanding of current pest management practices and the role that ladybirds can play in conserving cocoa crops.

Population

The study population includes 1 Theobroma cacao plantation in the department of Caquetá, where ladybirds have been reported in the surrounding area. The diversity of insect species present was identified and evaluated, as well as their geographical distribution and potential as natural biological control agents.

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Location

Figure 1. Location of Caquetá. Source: Google. (2023). Map of the Caquetá region, Colombia. Google Earth.

Research approach

The study's methodological approach is mixed, combining qualitative and quantitative methods. This approach is justified by the need to obtain accurate data on the population of ladybirds and their interaction with cocoa cultivation, as well as to understand farmers' perceptions and knowledge of the use of these insects as biological control agents.

Documentary analysis was also used. This consists of exploring various documents that serve as sources of information on a specific research object, such as life stories, diaries, and institutional and personal archives.

This process begins with the identification and inventory of available documents that provide relevant information on the subject of study. Subsequently, these documents are classified and selected according to the information's importance and relevance to the research. Once the final selection has been made, an exhaustive review of the content is carried out, and the relevant information is recorded orderly to be used for analysis according to the study's objectives. [15,16]

Method

Analyzing the producer's knowledge about the insects associated with his cocoa crop and whether he recognizes them as pests or beneficial is important for implementing natural biological control to avoid the use of agrochemicals.

The interview tool will be used to gather the required information. This interview aims to obtain valuable information on management practices, identify problems, and implement solutions in the production process.

RESULTS

We can see how the producer associates the insects on his property with "pests." He sees them as pests that he has to exterminate, carrying out control with agrochemicals, a quick and effective solution, according to [2] the use of insecticides that kill a broad spectrum of insect species can cause the appearance of several pests that were not previously considered harmful, which is quite logical; chemistry does not discriminate against any insect, whether beneficial or not.

Figure 2. Word cloud: biological control in cocoa.

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We can conclude that "Time" is also a factor of utmost importance since, logically, the producer seeks efficiency in time, something that he achieves perfectly with chemical control, but at the cost of prolonged damage that, in the long run, will become a problem with no return.

In addition, the "Expense" involved in chemical maintenance should also be highlighted. The costs associated with chemical maintenance in cocoa crops are significant and can impact producers' profitability due to the investments needed in fertilizers and agrochemicals to ensure the health of the plants and optimize yield.[4]

Sankey diagram

The producer faced several challenges when he first started growing the crop. He had to colonize and "deforest" to cultivate the cocoa hectare. He has overcome challenges with a lot of dedication and hard work, such as "phytosanitary problems." Phytosanitary control in cocoa crops is crucial to prevent diseases and pests that can affect the quality and quantity of the harvest, which implies the implementation of integrated management practices that not only protect the plant but also promote a sustainable agricultural.[5] Reasonable phytosanitary control prevents many problems and pests, as well as good fertilizer, irrigation, pruning, and excellent pest control. For this, it is necessary to know the insects. The producer has acquired empirical knowledge that has allowed him to control the pests, but in a traditional way (agrochemicals), which means an additional expense.

When the producer realizes that there is an "alternative" to traditional control, an "interest" in "biological control" is born because, according to [2] biological control is one of the cheapest, safest, most selective, and efficient methods of pest control, which is why producers should turn to it. However, farmers' limited understanding of biological control techniques can diminish the effectiveness of these practices, which in turn impacts the health of the crops and the sustainability of their agricultural systems.[6] The farmers worried that the cheapest and most environmentally friendly method was not considered or applied effectively in the territory. Farmers tend to acquire knowledge through traditional methods, such as oral transmission and observation of cultivation techniques from previous generations, which highlights the importance of agricultural culture in practical learning.[7] This means that if a farmer takes on the role of teaching others, the task will be easier. [13,14]

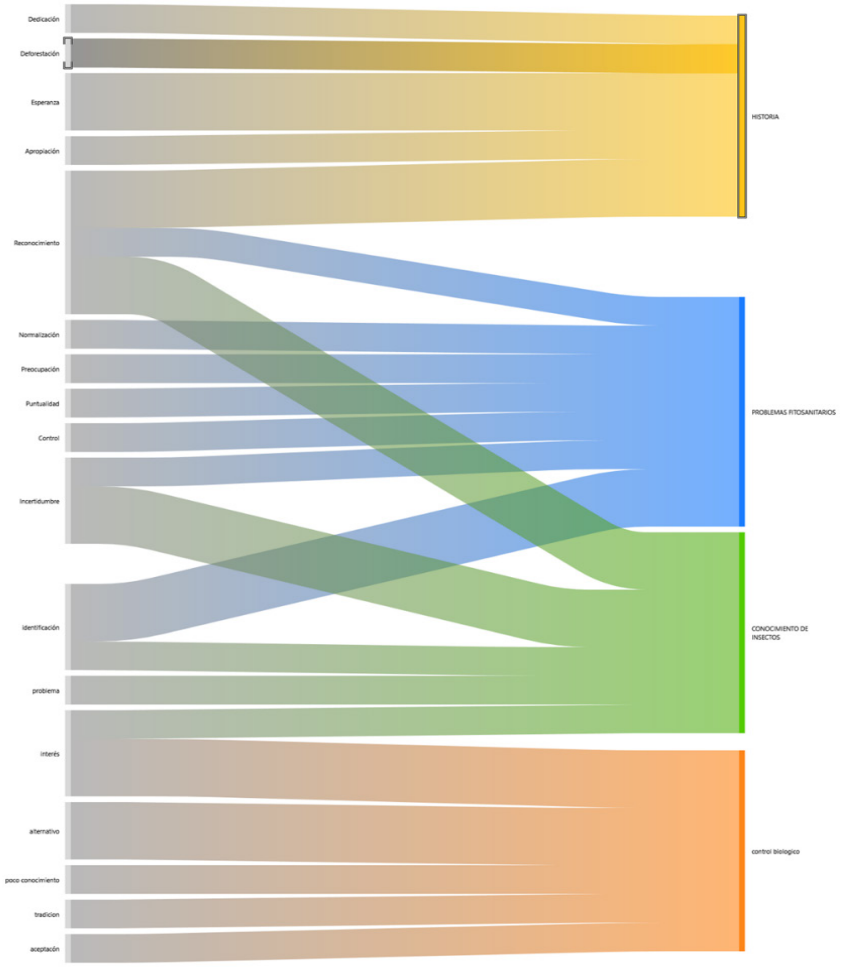

Figure 3. Sankey diagrams for biological control

Codes (networks)

When examining knowledge of insects, specifically ladybirds, farmers first have to know the problems, the main one being "phytosanitary problems," which generates concern and a "commitment" to find a solution. Farmers use a variety of pest management strategies, ranging from biological controls and cultural methods to applying pesticides, seeking a balance that minimizes environmental impact and guarantees sustainable production.[8] In this case, the producer is unaware of the biological control method, which means he has an additional expense and, therefore, becomes dependent on agrochemicals. However, when he sees or learns about the possible damage, he becomes aware and looks for an alternative response to the problem. Farmers are beginning to consider biological control as a viable alternative to agrochemicals, as they recognize its benefits in terms of environmental sustainability and reduction of toxic waste, which promotes more responsible agriculture.[8]

However, despite the benefits of biological control, many farmers lack technical assistance and training, which limits their ability to adopt these sustainable practices in their production systems.[9] It is a relatively large and long field of action if you want to get farmers to implement biological control, starting with identifying beneficial insects such as ladybirds, which are predators of the main cocoa pests.[10,11]

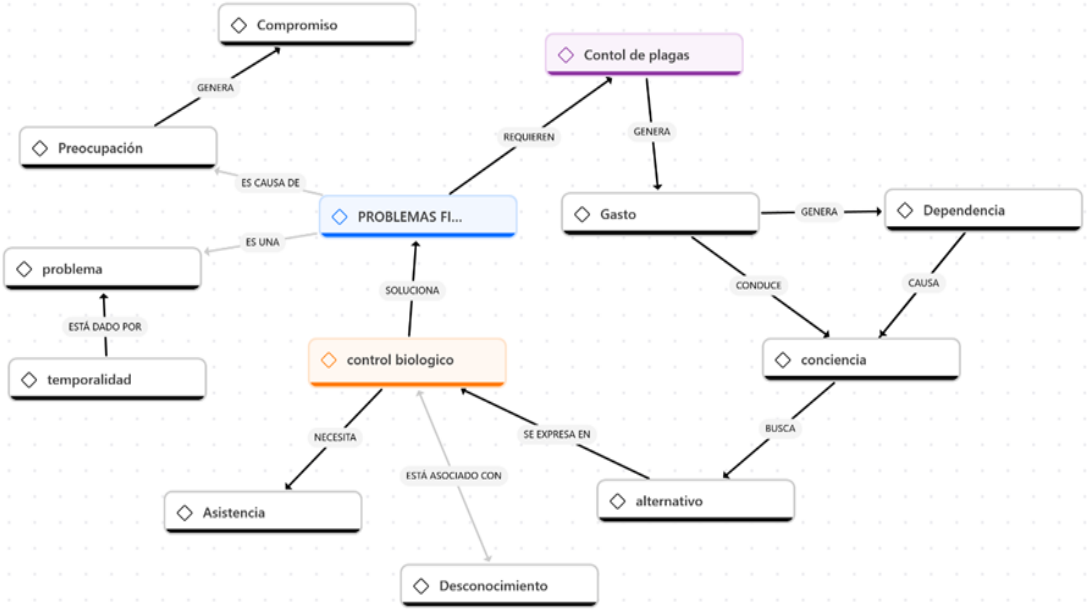

Figure 4. Conceptual map of biological control

CONCLUSIONS

Farmers learn empirically and practically and share their knowledge with other farmers, generating a chain of knowledge that becomes a tradition.

The overuse of agricultural chemicals on the cacao plants in Caquetá has damaged the variety of life in the area, altering creatures that are useful and essential for maintaining a healthy crop ecosystem.

Farmers like Hernando Susunaga are interested in biological control and pest predators. However, their lack of knowledge and dependence on traditional agricultural methods prevent them from using more ecological options.

We urgently need to educate farmers about ecological agriculture, help them stop using chemicals, and make cocoa cultivation more sustainable.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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