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Effects of Crop Management, Farming Systems, And Semi natural Habitats at the Landscape Scale on Biological Control of Insect Pests in Agro ecosystems

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ABSTRACT: A rising body of data suggests that land use simplification combined with a heavy reliance on pesticide inputs is lowering environmental quality, endangering biodiversity, and increasing the risk of pest outbreaks. The development of agricultural methods that rely more heavily on ecosystem services, such as biological insect pest management, should improve agroecosystem sustainability. The variables that contribute to the preservation or improvement of natural pest control, on the other hand, are unknown. The aim of this study is to reveal which factors affect natural enemy populations and pest control at various scales, from the field to the landscape. In order to assess their relative significance and identify important factors that govern natural pest control interactions, we describe here the main impacts of semi natural habitats, farming methods, and crop management on the abundance of insect pests and their biological control. We propose a thorough description of cropping systems and an explicit consideration of semi natural habitats and the surrounding environment in research exploring trophic interactions and biological pest management because of the variety of geographical and temporal scales encountered by these species. We also highlight information gaps and show the value of combining agronomy and landscape ecology to better understand trophic relationships, optimize natural pest management, and reduce pesticide use. A key stage in the design and evaluation of ecologically sound integrated pest control systems for farmers is quantifying the relative significance at both local and landscape scales.

KEYWORDS: Agro, Crop, Ecosystem, Habitats, Biological.

1. INTRODUCTION

Baessler and Klotz found that modern agricultural landscapes include a high percentage of arable fields, large field sizes, and a significant degree of fragmentation of seminatural habitats into tiny units .A increasing body of data suggests that land use simplification, coupled with a heavy reliance on pesticide inputs, is lowering environmental quality and endangering biodiversity .To maintain the long-term viability of agricultural output, it is thus necessary to minimize pesticide usage by creating new cropping systems.Agroecosystems and landscapes should be more sustainable if biodiversity protection and the development of agricultural methods that rely more on ecosystem services are combined . Production, nutrient cycling, flood management, temperature regulation, biological pest control, and aesthetic value are all examples of ecosystem services [1].

An agro ecosystem’s long-term viability is dependent on a variety of ecosystem services, but it may also be harmed by ecosystem disservices like herbivory, which reduce productivity and raise production costs For these reasons, natural pest regulation is regarded as one of the most valuable services provided by biodiversity, with a global value of more than 400 billion dollars each year .Pesticide usage, in fact, has been linked to a significant reduction in natural pest

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management services. Thus, improving the natural regulatory functions of agroecosystems seems to be one of the most important methods to reduce the usage of chemical pesticides for pest management while also increasing crop sustainability .The variables that contribute to the preservation or improvement of natural pest control, on the other hand, are unknown. Furthermore, in the lack of strong scientific data, the environmental and economic advantages to farmers of boosting the activity of natural enemies of agricultural pests remain a point of contention. Biological management is dependent on many levels spanning from field to landscape sizes, according to recent studies [2].

Spatial context has been shown to affect community structure, species richness and abundance, population dynamics, and interactions within and between trophic levels. In agroecosystems, crop management and farming methods have been demonstrated to have significant impacts on species composition, abundance, and distribution. However, little research has been done on the relative contributions of crop management, agricultural methods, and landscape context on pest abundance, natural enemy abundance, and biological control .We examine themajor impacts of landscape context, farming methods, and crop management on insect pest abundance and biological control in order to assess their relative significance and identify important factors that govern natural pest control interactions.With the goal of giving a comprehensive picture of all the mechanisms and interactions involved in biological regulatory processes, we examine a system with three trophic levels as a generic framework, using host–parasitoid interactions as an example.

We'll start by looking at the variables that influence arthropod dynamics at the landscape level. The importance of seminatural habitats for pest and natural enemy populations will be discussed next, followed by a brief review of the major impacts of landscape context on natural pest management. The state of the art on the connections between natural enemy biodiversity and pest control will next be presented.Following that, we'll look at the impact of different crop management components on pest and natural enemy populations at a local size. After that, the impacts of farming methods on trophic interactions will be evaluated in order to discover biological control mechanisms at the farm level. This will lead to the conclusion, where we will emphasize the importance of examining the combined impacts of landscape, farming methods, and crop management on biological control interactions, with an emphasis on the effects of crop management, which are often overlooked. We will emphasize the significance of accurate descriptions of crop areas, crop management, and seminatural habitats in studies of trophic interactions throughout this review, as well as the immediate advantages of such methods for integrated pest control tactics. Trophic Interactions and Arthropod Dynamics in the Agricultural Landscape[3].

Studies of population dynamics and community ecology need large-scale methods. The importance of a large-scale viewpoint in predator–prey interactions was first recognized in spatial ecology research, primarily via theoretical and empirical investigations on the structure and dynamics of fragmented population’s .Theoretical knowledge of the dynamics of insect pests and their natural antagonists in fragmented environments has improved because to studies on met populations. The geographic persistence of a population is enabled by a stochastic equilibrium between the extinction of local populations and the colonization of previously vacant habitat

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patches, according to met population theory The driving factors underlying the regional survival of host–parasitoid populations have been proposed to be habitat fragmentation and dispersion capacity Such systems' population dynamics are extremely varied and are influenced by species traits and landscape structure.

When a population's hosts are distributed in discrete patches, local populations on patches have a high probability of extinction, unoccupied patches are available for colonization, and local subpopulations do not fluctuate asynchronously, Hanski and Gilpin define a population as a met population. The fourth criterion is unknown since climatic variables have a significant impact on insect pest dynamics. The tiny body size, rapid rate of population growth, and specialization of host–parasitoid interactions are believed to predispose them to met population dynamics .Experiments identifying essential variables that promote host–parasitoid met population are, however, few. They showed that I population structures of different host–parasitoid systems are highly variable, parasitoids and their hosts generally respond to spatial subdivision at different spatial scales, parasitoids can cause local extinction of host populations, and parasitoids are usually more prone to extinction than their hosts.Population responses to habitat loss and fragmentation have been studied in spatial ecology. One of many spatial population patterns that may develop is a classical met population.

Metapopulations of mainland-island persons ephemeral aggregations of individuals, isolated populations, and synchronized local populations are some of the others used modeling to show that for host–parasitoid systems, five classes of spatio-temporal dynamics could be distinguished by varying three parameters: proportion of suitable habitat, spatial autocorrelation, and host dispersal rate. This research found that dispersion rate and landscape design are important variables in local extinction and colonization events, emphasizing the significance of considering landscape-scale and species-specific characteristics when studying population dynamics and tropic interactions [4].

2. DISCUSSION

2.1. Application:

Sustain populations of alternate hosts and prey for crop pest parasitoids and predators. This improves natural pest management by supplying alternate hosts and prey to pests' natural enemies during times when host and prey density in fields is low, or by improving the fitness of natural enemies. When prey availability in noncrop environments is limited, ladybeetle populations are more susceptible to food shortages [5].

However, following pest infestation of crops, natural enemy populations may increase dramatically, resulting in a spillover effect, with these insects moving to seminatural habitats, where they may deplete the prey populations of other nonmeat species, potentially reducing the size of populations of beneficial secondary zoophagous species .For generalist predators that feed on a range of prey species, natural enemy populations are more reliant on alternate prey or hosts than for specialized predator species. Honeydew is consumed by several parasitoids and other natural enemies. As a result, the availability of sap-feeding alternative prey in noncrop environments may help reduce crop pests. Evans and England discovered that when pea aphids were present, levels of alfalfa weevil parasitism by the ichneumon wasp Bathyplectes curculionis were greater. Access to pea aphid honeydew seemed to substantially enhance the wasp's fertility and adult life span. Alternative prey may also help with pest biological management by reducing

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intraguild predation also found that providing alternative food, such as unparasitized aphids, reduced parasitoid mortality caused by predators eating mummified aphids.

Habitats that provide alternate hosts or prey, on the other hand, may be able to tolerate pest species, resulting in an increase in pest populations. Indeed, found that floral resource subsidies may affect phytophagous insects and their natural adversaries in a variety of ways. Some plant species improve the fitness of herbivores and parasitoids, whereas others selectively improve parasitoid fitness. And Wyss showed that sown wildflower strips increase the fitness of natural enemies of crop pests sufficiently to contain the increase in pest populations, which may also benefit from the wildflower strips. reported similar effects on different insect pests, but Wyss showed that sown wildflower strips increase the fitness of natural enemies of crop pests sufficiently to contain the increase in pest populations, which may also benefit from the Pollen and nectar are important for many species, and seminatural environments provide them Several studies have found that more diverse vegetation, such as flowering weeds, results in increased pollen and nectar availability, resulting in higher densities of carbide beetles syrphid flies and parasitoid. Many hymenopteran parasitoid species have also been shown to feed on floral nectar which may contribute to increased parasitism rates found that nectar feeding is critical for Diadegma semiclausum survival and fecundity in field settings.

They discovered that when female parasitoids were denied nectar, parasitism rates were extremely low, but that when females were given enough food, parasitism rates were considerably greater. Wackers examined sugar consumption patterns of the parasitic Cotesia glomerata and its phytophagous host, Pieris brassicae. He discovered that the parasitoid consumed more sugar kinds than its host, and that certain sugars enhanced the parasitoid's life span by a ratio of 15, while the host's life span was only boosted by a factor of three. Sustain populations of alternate hosts and prey for crop pest parasitoids and predators. This improves natural pest management by supplying alternate hosts and prey to pests' natural enemies during times when host and prey density in fields is low, or by improving the fitness of natural enemies. Bianchi and van der for example, used simulation to demonstrate that if pest aphid infection of wheat is delayed, populations of the generalist predator Coccinella septempunctata become more reliant on aphid numbers in noncrop environments. When prey availability in noncrop environments is limited, ladybeetle populations are more susceptible to food shortages. However, following pest infestation of crops, natural enemy populations may increase dramatically, resulting in a spillover effect, with these insects moving to seminatural habitats, where they may deplete the prey populations of other nonmeat species, potentially reducing the size of populations of beneficial secondary zoophagous species [6].

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be able to tolerate pest species, resulting in an increase in pest populations. Found that floral resource subsidies may affect phytophagous insects and their natural adversaries in a variety of ways. Some plant species improve the fitness of herbivores and parasitoids, whereas others selectively improve parasitoid fitness. Figure 1 discloses the potential effects of crop management and semi natural habitats on each level of a tritrophic chain (solid lines). Dotted lines represent the tropic interactions between each element of the tritrophic chain [7].

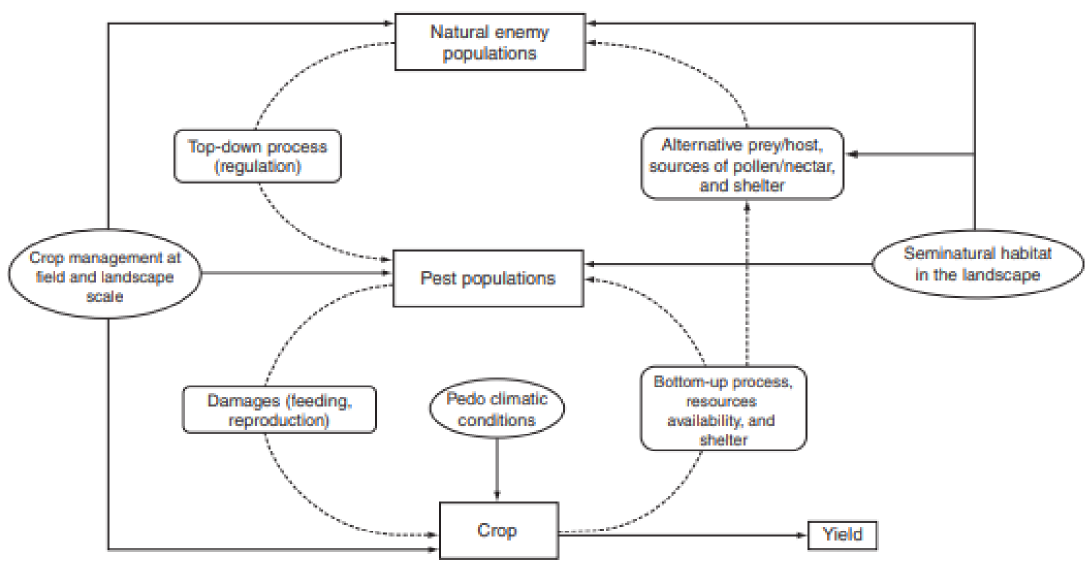

Figure 1: The Potential Effects of Crop Management and Seminatural Habitats on Each Level of a Tritrophic Chain (Solid Lines). Dotted Lines Represent the Trophic Interactions between Each Element of the Tritrophic Chain.

2.2. Working:

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Natural enemies are frequently protected from severe temperature fluctuations by woody areas, which offer a milder microclimate than the middle of fields. Due to a moderate mild environment and nectar availability, parasitism levels of insect pests are greater and closer to the margins of fields bordering noncrop areas than in the middle of fields. Seminatural environments also offer excellent overwintering conditions for natural enemies and pests, influencing their geographic distribution in the spring. They enable Episyrphus balteatus, a prominent aphid predator syrphid fly, to overwinter at various stages in various kinds of shelter, for example. It spends the winter

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as adult females at the southern borders of fragmented woods and as final larvae along the northern ones where aphids formed in the autumn, defining its geographical distribution in the spring .According to Keller and Hani nine out of ten auxiliary species need a noncrop habitat at some point throughout their life cycle, while only one out of every two pest species does. As a result, most auxiliary species are highly reliant on the nutrients supplied by seminatural regions, forcing them to go back 228 miles. The previous discussion of the agro ecological functions of seminatural habitats showed the complementary nature of crop and noncrop regions for pests and their natural enemies, emphasizing the importance of habitat boundaries [9].

In one kind of habitat may subsidize shared consumers, causing them to have a larger effect on resources in the other type of habitat. Seminatural habitats have long been thought to be significant sources of natural enemies that move into agricultural fields, possibly improving pest biological management if they are near enough to the field. The diversity of nutrients available in seminatural environments enables beneficial arthropod populations to grow, which subsequently spread to agricultural fields.

Indeed, research has shown that the quality and quantity of seminatural habitat patches next to the crop may influence top-down management The direction of spillover effects is determined by Biological Control of Insect Pests in Agroecosystems 229 Spillover impacts from more productive ecosystems have a significant impact on low-productivity areas. Indeed, highly productive systems like cultivated areas support greater prey densities, resulting in bigger natural enemy populations and higher rates of passive spread to less productive environments. It has also been shown that the magnitude and direction of spillover effects are significantly influenced by the temporal dynamics of resources throughout the landscape, especially between cultivated and seminatural habitats.

Indeed, agricultural landscape resources change dramatically over time, since farmed ecosystems only offer high-quality resources for a portion of the year. Because of the sudden decrease in habitat quality caused by harvesting, predators are actively emigrating from cultivated regions to more stable seminatural environments. Spillover effects may also arise from resource complementation in seminatural and farmed regions, according to The larger aggregation of predators and stronger top-down control near field margins may be explained by the availability of resources in both kinds of habitat and the beneficial consequences of this complementation on fecundity and lifespan[10].

3. CONCLUSION

Ecological studies offered a solid theoretical foundation for understanding how species are likely to react to landscape context and how population dynamics are established at the landscape scale. However, such studies have often ignored the variety of agricultural regions and their management practices, believing that arable land is homogeneous. We showed in our study of the impacts of crop management on trophic interactions that agricultural techniques may play a significant role in controlling natural enemy and pest populations at a local scale. In landscape studies, a detailed description of crop management seems to be critical for identifying the main driver of biological control and evaluating the impacts of landscape, farming system, and farming methods. This is a crucial stage in developing and evaluating environmentally friendly integrated pest control methods for farmers. In terms of agro ecological roles for natural enemies and pests, it's also critical to assess the quality of seminatural regions. In order to develop integrated pest control strategies for use at the landscape scale, agronomists and ecologists must take into account the habitat quality of crop and noncrop regions for pests and their natural enemies.

Furthermore, all of the research examined here focused on either crop management or the agricultural system at the local level, rather than farming methods throughout the whole terrain. However, since pests and their natural enemies encounter a wide variety of geographical and temporal scales, agricultural practices in the surrounding environment are likely to affect trophic interactions. Studies will need to take into consideration the specific features of seminatural habitats, local crop management impacts, and landscape farming methods if we are to understand how species respond at the landscape scale. Pests and their control, according to the integrated pest management paradigm, exist at the intersection of three main multidimensional areas of study: ecology, socio-economics, and agronomy, with increasing degrees of complexity and geographical scales.

Integrated pest management strategies can be thought of as the combination of different techniques to achieve three main goals. Although this assertion has not been clearly demonstrated, studies on the effects of landscape and farming practices on natural pest control do not generally consider all three objectives, the consideration of landscape features in biological control-based pest management strategies appears to be a relevant approach. To begin with, increasing natural enemy numbers does not always indicate successful pest management, because crop-noncrop habitat interactions are complicated and may be antagonistic.

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