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ANTAGONISTIC INTERACTION AGAINST PLANT INSECTS

[1]Yash Sharma, [2]Richa Bharti

[1,2] *Department of Basic and Applied Science,*

Modi Institute of Management and Technology, Kota, Rajasthan, (India)

ABSTRACT

Plants and insects have been co-existing for more than 400 million years, leading to intimate and complex relationships. Many insects are harmful for plants species which put the negative effects on plant and destroy yields but some host insect have ability to kill harmful insects , those have specific competition between plants focused insects can have synergistic effects on the growth and performance of the attacked host plant. Rather than killing the whole plant, insects affect on plant growth and productiveness and can thereby affect the competitive ability of the attacked plant. Herbivore-induced shifts in the competitive chain of command of plant species are often invoked to explain the effects of herbivorous insects on the structure and dynamics of plant communities to capture resources for regrowth and herbivore defense depends on the competitive regime. We conclude that both competitor identity and the herbivore's ability to respond with changes in its density or activity to plant competition affect the direction (synergistic vs. antagonistic) of the interaction between competition and herbivory on plant growth.

Keywords: Antagonistic, Herbivorous, Insects, Synergistic effects

I INTRODUCTION

Insects and plants have co-existed for more than 400 million years and have been engaged since then in a running arms race: while insects have to face plant save and evolve strategies to overcome them, plants tend to reduce herbivory through diverse mechanisms.

In parallel, plants and insects have established different types of relationships with microbial associates that could influence the outcomes of the interactions. Microbes may modulate plant primary and secondary metabolisms and/or plant defence systems against insects for the benefit of either plants or insects. Microbes may also change insect biology, including metabolism and behavior, and have a significant influence on plant–insect interactions. Microbes can act directly or indirectly on the traits of insects that participate in habitat and resource exploitation and/or in survival under stressed conditions. Progress has been made in describing the

Biological interactions are the effects that the organisms in a community have on one another. In the natural world no organism exists in absolute isolation, and thus every organism must interact with the environment and other

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organisms. An organism's interactions with its environment are fundamental to the survival of that organism and the functioning of the ecosystem as a whole.

In Ecology, biological interactions can involve individuals of the same species (intraspecific interactions) or individuals of different species (interspecific interactions). These can be further classified by either the mechanism of the interaction or the strength, duration and direction of their effects. Species may interact once in a generation (e.g. pollination) or live completely within another (e.g. endosymbiosis). Effects range from consumption of another individual (predation, herbivory, or cannibalism), to mutual benefit (mutualism). Interactions need not be direct; individuals may affect each other indirectly through intermediaries such as shared resources or common enemies.

Biological control is a method of controlling pests such as insects, mites, weeds and plant diseases using other organisms. It relies on predation, parasitism, herbivory, or other natural mechanisms, but typically also involves an active human management role. It can be an important component of integrated pest management (IPM) programs.

There are three basic types of biological pest control strategies: importation (sometimes called **classical biological control**), in which a natural enemy of a pest is introduced in the hope of achieving control; augmentation, in which locally-occurring natural enemies are bred and released to improve control; and conservation, in which measures are taken to increase natural enemies, such as by planting nectar-producing crop plants in the borders of rice fields.

Natural enemies of insect pests, also known as biological control agents, include predators, parasitoids, and pathogens. Biological control agents of plant diseases are most often referred to as antagonists. Biological control agents of weeds include seed predators, herbivores and plant pathogens.

Biological control can have side-effects on biodiversity through predation, parasitism, pathogenicity, competition, or other attacks on non-target species, especially when a species is introduced without thorough understanding of the possible consequences.

Biological control techniques as we know them today started to emerge in the 1870s. During this decade, in the USA, the Missouri State Entomologist C. V. Riley and the Illinois State Entomologist W. LeBaron began within-state redistribution of parasitoids to control crop pests. The first international shipment of an insect as biological control agent was made by Charles V. Riley in 1873, shipping to France the predatory mites *Tyroglyphus phylloxera* to help fight the grapevine phylloxera (*Daktulosphaira vitifoliae*) that was destroying grapevines in France. The United States Department of Agriculture (USDA) initiated research in classical biological control following the establishment of the Division of Entomology in 1881, with C. V. Riley as Chief. The first importation of a parasitoid into the United States was this of *Cotesia glomerata* in 1883–1884, imported from Europe to control the imported cabbage white butterfly, *Pieris rapae*. In 1888–1889 the vedalia beetle, *Rodolia cardinalis*, which is a ladybug, was

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introduced from Australia to California to control the cottony cushion scale, *Icerya purchasi*. This had become a major problem for the newly developed citrus industry in California, and by the end of 1889 the cottony cushion scale population had already declined. This great success led to further introductions of beneficial insects into the USA.[5]

In 1905 the USDA initiated its first large-scale biological control program, sending entomologists to Europe and Japan to look for natural enemies of the gypsy moth, *Lymantria dispar dispar*, and brown-tail moth, *Euproctis chrysorrhoea*, invasive pests of trees and shrubs. As a result, nine parasitoids of gypsy moth, seven of brown-tail moth, and two predators for both moths became established in the USA. Although the gypsy moth was not fully controlled by these natural enemies, the frequency, duration, and severity of its outbreaks were reduced and the program was regarded as successful. This program also led to the development of many concepts, principles, and procedures for the implementation of biological control programs.

The first reported case of a classical biological control attempt in Canada involves the hymenopteran parasitoid *Trichogramma minutum*. Individuals were caught in New York State and released in Ontario gardens in 1882 by William Saunders, trained chemist and first Director of the Dominion Experimental Farms, for controlling the imported currantworm *Nematus ribesii*. Between 1884 and 1908, the first Dominion Entomologist, James Fletcher, continued introductions of other parasitoids and pathogens for the control of pests in Canada.

II TYPES OF BIOLOGICAL PEST CONTROL

There are three basic biological pest control strategies: importation (classical biological control), augmentation and conservation.

2.1 Importation

Rodolia cardinalis, the vedalia beetle, was imported to Australia in the 19th century, successfully controlling cottony cushion scale.

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Importation or classical biological control involves the introduction of a pest's natural enemies to a new locale where they do not occur naturally. Early instances were often unofficial and not based on research, and some introduced species became serious pests themselves.[8]

To be most effective at controlling a pest, a biological control agent requires a colonizing ability which allows it to keep pace with the spatial and temporal disruption of the habitat. Control is greatest if the agent has temporal persistence, so that it can maintain its population even in the temporary absence of the target species, and if it is an opportunistic forager, enabling it to rapidly exploit a pest population.

Joseph Needham noted a Chinese text dating from 304 AD, *Records of the Plants and Trees of the Southern Regions*, by Hsi Han, which describes mandarin oranges protected by large reddish-yellow citrus ants which attack and kill insect pests of the orange trees. The citrus ant (*Oecophylla smaragdina*) was rediscovered in the 20th century, and since 1958 has been used in China to protect orange groves.

One of the earliest successes in the west was in controlling *Icerya purchasi* (cottony cushion scale) in Australia, using a predatory insect *Rodolia cardinalis* (the vedalia beetle). This success was repeated in California using the beetle and a parasitoid fly, *Cryptochaetum iceryae*.

2.2 Biological control agents

Predators are mainly free-living species that directly consume a large number of prey during their whole lifetime. Ladybugs, and in particular their larvae which are active between May and July in the northern hemisphere, are voracious predators of aphids, and also consume mites, scale insects and small caterpillars. The spotted lady beetle (*Coleomegilla maculata*) is also able to feed on the eggs and larvae of the Colorado potato beetle (*Leptinotarsa decemlineata*).

The larvae of many hoverfly species principally feed upon greenfly (aphids), one larva devouring up to 400 in its lifetime. Their effectiveness in commercial crops has not been studied.

Several species of entomopathogenic nematode are important predators of insect and other invertebrate pests. *Phasmarhabditis hermaphrodita* is a microscopic nematode that kills slugs. Its complex life cycle include a free-living, infective stage in the soil where it becomes associated with a pathogenic bacteria such as *Moraxella osloensis*. The nematode enters the slug through the posterior mantle region, thereafter feeding and reproducing inside, but it is the bacteria that kill the slug. The nematode is available commercially in Europe and is applied by watering onto moist soil.

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2.3 Parasitoids

Parasitoids lay their eggs on or in the body of an insect host, which is then used as a food for developing larvae. The host is ultimately killed. Most insect parasitoids are wasps or flies, and may have a very narrow host range. The most important groups are the ichneumonid wasps, which prey mainly on caterpillars of butterflies and moths; braconid wasps, which attack caterpillars and a wide range of other insects including greenfly; chalcid wasps, which parasitize eggs and larvae of greenfly, whitefly, cabbage caterpillars, and scale insects; and tachinid flies, which parasitize a wide range of insects including caterpillars, adult and larval beetles, and true bugs.

2.4 Combined use of parasitoids and pathogens

In cases of massive and severe infection of invasive pests, techniques of pest control are often used in combination. An example is the emerald ash borer, *Agrilus planipennis*, an invasive beetle from China, which has destroyed tens of millions of ash trees in its introduced range in North America. As part of the campaign against it, from 2003 American scientists and the Chinese Academy of Forestry searched for its natural enemies in the wild, leading to the discovery of several parasitoid wasps, namely *Tetrastichus planipennisi*, a gregarious larval endoparasitoid,*Oobius agrili*, a solitary, parthenogenic egg parasitoid, and *Spathius agrili*, a gregarious larval ectoparasitoid. These have been introduced and released into the United States of America as a possible biological control of the emerald ash borer. Initial results have shown promise with *Tetrastichus planipennisi* and it is now being released along with *Beauveria bassiana*, a fungal pathogen with known insecticidal properties.

2.5 Indirect control

Pests may be controlled by biological control agents that do not prey directly upon them. For example, the Australian bush fly, *Musca vetustissima*, is a major nuisance pest in Australia, but native decomposers found in Australia are not adapted to feeding on cow dung, which is where bush flies breed. Therefore, the Australian Dung Beetle Project (1965–1985), led by Dr. George Bornemissza of the Commonwealth Scientific and Industrial Research Organisation, released forty-nine species of dung beetle, with the aim of reducing the amount of dung and therefore also the potential breeding sites of the fly.

III CONCLUSION

This review article shows the impact of insects on plants and Antagonistic interaction against plant insects. A prospective problem to the adoption of biological pest control measures is growers stick to the familiar use of pesticides. It has been claimed that many of the pests that are controlled today using pesticides, in fact became pests because pesticide use summary or eliminate natural predators. A method of increasing grower adoption of biocontrol involves is letting growers learn by doing, for example showing them simple field experiments, having observations of live predation of pests, or collections of parasitised pests. In the Philippines, early season sprays against leaf

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folder caterpillars were common practice, but growers were asked to follow a 'rule of thumb' of not spraying against leaf folders for the first 30 days after transplanting; participation in this resulted in a reduction of insecticide use by 1/3 and a change in grower perception of insecticide use.

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