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Spiders' Impact on Controlling Insect Pests in the Agricultural Ecosystem

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ABSTRACT

Spiders rate as one of the best instruments for biological pest control available to gardeners, despite the fact that many people have an innate fear of them. The majorities of spiders are harmless and are essential for controlling the insect population. Spiders are generalist predators that may occupy a wide range of ecological niches, enabling them to intercept and feed on a wide diversity of insect species. Within agricultural settings, this quality might be especially beneficial.

KEYWORDS: Spiders, Agriculture, Ecosystem, Diversity.

INTRODUCTION

Insecticides have been used extensively to manage agricultural pests for many years.However, continued use of a range of pesticides has resulted in a number of unfavorable side effects, including the extinction of species, the problem of secondary pests, insecticide resistance, residual toxicity, the return of insect pests, and environmental pollution. Several attempts to combine various non-chemical control methods with insecticides in Integrated Pest Management systems have been attempted in recent years (IPM).One such strategy is to use pests' natural enemies, such as spiders, to inhibit their growth. A number of papers have suggested employing parasitic and predatory natural enemies to control agricultural pests (Van den Bosch et al. 1982).Spiders are members of the order Arachnid, subclass Araneae, and class Arachnida. Due to their varied hunting tactics, habitat preferences, and activity schedules, a diversified set of spiders may be useful in biological control. Spiders react to prey density in both a functional and numerical way. Spider populations in agrosystems are stable as a result of these density-dependent responses and polyphagy. In agricultural fields, spiders are an effective biocontrol agent since they exhibit tolerance and occasionally even resistance to pesticides. The importance of spiders in reducing the population densities of pest insect species has long been recognised (Pickett et al. 1946; Dondale 1956; Kajak et al. 1968; Fox and Dondale 1972; Tanaka 1989). In places with temperate temperatures, spider colonies, in particular, achieve equilibrium in the control of agricultural pests (Riechert 1981).However, due to a lack of knowledge on the ecological significance of spiders in pest management, they have often not been considered a significant biological control agent (Turnbull 1973, Riechert and Lockley 1984). However, research has shown that spiders can serve as important predators in rice fields to reduce the numbers of planthoppers and leafhoppers (Hamamura 1969, Sasaba et al. 1973, Gavarra and Raros 1973, Samal and Misra 1975, Kobayashi 1977, Chiu 1979, Holt et al. 1987, Tanaka 1989).Spiders are one of the distinctive components of biocontrol that may be employed successfully in both perennial horticulture and field crops.

They are 40,000 different species of carnivorous arthropods that may be found all over the planet in practically every type of environment. Though they may also eat a variety of other food, they mostly hunt insects. In agricultural areas, spider communities can have population densities and species abundances that rival those of natural ecosystems (Turnbull 1973, Tanaka 1989, Riechert 1981).

SPIDER:ONE OF THE BEST PREDATORS IN THE AGRICULTURAL ECOLOGY

Competition for food does not control the population size of herbivores. The finding that there are numerous green plants supports this theory (Hairston et al. 1960). Predation is therefore thought to serve as a constraint on herbivore populations. However, a few minor physical and chemical disturbances have caused the local extinction of predators in many agricultural settings (Maloney et al., 2003). Sometimes, when herbivores are overabundant and no longer under the predators' control, they cause catastrophic damage to crop plants (Maloney et al., 2003). Their population may be reduced if a predator could be introduced that would eat these herbivores. Such predators may include spiders (Sunderland, 1999).Despite the fact that the spiders (Araneae) are a diversified arachnid order with more than 3500 species in North America (Young and Edwards, 1990), many of them prey on nuisance insects that are herbivorous. The Diptera, Homoptera (leafhoppers), and Orthoptera, particularly grasshoppers, are the primary prey of the orb-web weavers Araneidae and Tetragnathidae. The smaller, sheet-web weavers, which belong to the families Linyphiidae, Dictynidae, and Theridiidae, eat Diptera, Hemiptera,

Homoptera (especially aphids and leafhoppers), as well as Curculionidae weevils. The funnel-web weavers (Agelenidae, Atypidae, Ctenizidae, and Eresidae) feed on Orthoptera, Coleoptera, and Lepidoptera (Riechert and Bishop, 1990; Nyffeler et al., 1994a). Hunting spiders (Lycosidae, Oxyopidae, Themisidae, and Salticidae) frequently capture Orthoptera, Homoptera, Hemiptera, Lepidoptera, Thysanoptera, Diptera, Coleoptera, and Hymenoptera (Riechert and Bishop, 1990; Young and Edwards, 1990; Nyffeler et al., 1994).

SPIDERS CAN LOWER AND MAINTAIN PEST CONCENTRATIONS

Many workers have investigated how pesticides affect natural adversaries, particularly spiders in rice fields. The bulk of the studies showed that pesticide usage had a detrimental influence on the population densities of rice field spiders (Kuno 1968, Kuno and Hokyo 1970, Kawahara et al. 1971, Choi et al. 1978, Paik et al. 1979, Jang 1981, Ryu et al. 1984, Kim et al. 1984, Paik and Hwang 1990, Lee et al. 1993b, Bae et al. 1994).It was occasionally examined how hazardous different pesticides were to spiders.

Spiders can also have large top-down impacts, which means that when they are present, plant damage from insect herbivores is less than when they are missing. Because they frequently capture and kill more prey than they ingest, spiders can also regulate prey populations (Maloney et al., 2003). According to Riechert and Lockley (1984), a spider may kill up to 50 times as many prey animals as it eats.

Less research has been done on spiders' reproductive behaviour. Some spiders, particularly those that build webs, do exhibit an increase in fertility with rising prey intake. These spiders include *Ageienopsisaperta*(Agelenidae), *Mecynogeaiemniscata* (Walckenaer), *Neriene radiate* (Linyphiidae), and *Mecynogeaiemniscata* (Walckenaer) (Riechert and Lockley, 1984; Marc et aI., 1999). Longer generation durations than those of pest insect species restrict the extent to which this increase in fecundity can enable tracking of prey populations. While many insect pests have generation cycles of a few weeks, spiders are typically univoltine (Riechert and Lockley, 1984; Provencher and Vickery, 1988).

WHAT IMPACT DO PESTICIDES HAVE ON SPIDER POPULATIONS?

Chemical pesticides are often used by farmers to manage pests. Therefore, a biological control agent that is resistant to man-made pesticides would be perfect. Due in part to their comparatively lengthy lifespans, spiders may be more vulnerable to insecticides than other insects, yet certain spiders exhibit tolerance or even resistance to certain pesticides. According to Chiu (1979), because spiders have a longer generation interval than planthoppers and leafhoppers, it takes them longer to reestablish their population densities following the use of pesticides.Fungicides and herbicides have less of an impact on spiders than insecticides do (Yardin and Edwards, 1998). According to Theiling and Croft (1988) and Markandeya and Divakar (1999), spiders, such as the wolf spider *P. pseudoannuiata*, are particularly resistant to botanical pesticides like Neem-based compounds. However, this tolerance may be the result of genetic resistance bred over a period of continuous exposure (Theiling and Croft, 1988; Wisniewska and Prokopy, 1997; Yardin and Edwards, 1998; Marc et al., 1999; Tanaka et al., 2000). They are also typically more tolerant of organophosphates and carbamates than of pyrethroids, organochlorines, and various acaricides.

Other variables that affect how pesticides affect spiders include solvent type, soil type, moisture content, percentage of organic matter, temperature, and spraying time of day. Additionally, the spider's behaviour, prey preferences, hunting method, and microhabitat all affect how they react to pesticide applications (Marc et al., 1999). According to Wisniewska and Prokopy (1997), spider populations rose if pesticides were only applied early in the growing season. If the land is not treated with pesticides after the first week of June, spiders should have an opportunity to recolonize it. Since spiders may leave treated regions and return after the chemicals wear off, restricting the use of pesticides in space (e.g., applying them exclusively to specific plants or plots) also increases the number of spiders(Riechert and Lockley, 1984; Balanca and de Visscher, 1997).

SPIDER ASSEMBLAGE PRESERVATION AND IMPROVEMENT

Agriculture systems should be modified in ways that benefit spider requirements in order to preserve and improve spider populations. The diversity and density of spiders are intimately correlated with the structural complexity of the environment. A greater variety of microhabitats, microclimatic characteristics, alternative food sources, retreat sites, and web attachment sites are all provided by highly varied habitats, all of which promote spider colonisation and establishment (Riechert and Lockley, 1984; Young and Edwards, 1990). Some of the improvement and conservation initiatives include:

- Mulch is used in vegetable gardens. It offers humidity and protection.
- Offer houses or attachment points for webs, such as boxes, tall plants, or bundles of hay.
- Leave plant stems or areas that have been tilled as overwintering habitats.
- Plant flowers that attract prey.
- Use a pesticide that has less affects on spiders if you must apply pesticides, or spray when they are less active.
- In apple orchards, an increase in spider hunting activity is a result of growing foliage and plant complexity.
- Crop diversification: Makes alternate prey available.

CONCLUSION

In conclusion, spiders may be efficient herbivore pest predators and can exercise significant top-down control, frequently trapping more insects than they can eat. Despite the possibility of conflict and intraguild predation, a diversified collection of spiders may offer the best chance of preventing high pest populations. Given their longevity and resistance to hunger and desiccation, spiders may be useful biocontrol agents. Additionally, spiders are among the earliest predators capable of controlling pests and start active as soon as conditions are favourable. The hazards of utilising spiders to eradicate pests are quite low.

The capacity of spiders to reduce insect pests, as well as the geographic distribution of significant spider species and pests, should be quantitatively examined in the field on a large scale in order to successfully use spiders as biological control agents.

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