

Ecologically Dominant Spider Species and Their Effects on Insect Pests in Crops

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Abstract

Spiders are generalist predators that play a crucial role in regulating insect pest populations within agricultural ecosystems. Understanding the predatory efficacy of ecologically dominant spider species is essential for effective integrated pest management strategies. The dominant spider species in an ecosystem can have a significant ecological impact on controlling insect pests in crops. These spiders play a crucial role in regulating insect pest populations, contributing to natural pest control within agricultural ecosystems. By preying on insect pests, dominant spider species help to suppress pest populations, reducing crop damage and the need for chemical pesticides. This study aimed to investigate the impact of dominant spider species on controlling insect pests in various crop systems.

Keywords: Spider Species, Pest Control, Crop system, management strategies.

Introduction

Spiders have the ability to achieve large population densities within ecosystems, exert control over food webs, and exert influence on ecological processes. They have a crucial impact in preserving ecological balance. Spiders play a crucial role in controlling populations of aphids, planthoppers, mites, lepidopteran larvae, and eggs, as stated by [1]. They possess the ability to collect and swallow substantial quantities of prey without causing harm to the plants. The usual spider concentrations in both natural and farmed areas range from “50 to 150 individuals per square meter”. However, it is not uncommon for the densities to exceed 1000 individuals per square meter. Annual cropping systems are man-made and sustained through agronomic techniques like tillage, ploughing, weed harrowing, and crop harvesting, all of which adversely affect spider diversity. [2] suggests that perennial farming systems have less disturbances, which may result in a significantly higher number and density of spiders compared to annual cropping systems. Spiders have great promise in the field of conservation biological control for managing insect pests of crops. Recent studies have highlighted the significant role of spiders as generalist predators in this regard [3]. Controlling economically significant insect pests in crops is a crucial concern in agroecosystems. Hence, it is crucial to comprehend the dispersion, variety, and prevalence of spiders in different agroecosystems [4].

Materials and Methods

Evaluation of predation attributes

In order to assess the predation characteristics, a solitary spider species, which had not eaten for 12 hours prior to the experiment, was introduced into a Petri dish. The spider was then presented with a limited, ideal, or plentiful amount of a specific insect pest as potential prey for the following 24 hours. The spider's biomass, together with the biomass of any leftover prey, was quantified after a 24-hour period. In order to evaluate the natural decline in biomass of the particular insect pest, which serves as prey, The prey biomass defined for optimum number, high prosperity and rarity (as previously described) was separated separately under the prescribed abiotic circumstances for a whole day without the presence of predators. After that, the carcass biomass had been reweighed, and for every state of prey your availability, this procedure was done ten times, for each species of insect pest being studied, and for each species of predator. Using the modified techniques, the developmental pace, efficient conversion, and feeding rate of each kind of web were determined from [5].

Growth rate per day=

$$\frac{\text{Fresh mass gain by predator mg}}{\text{Fresh mass gain by predator mg Feeding duration days} \times \text{Mean biomass of predator (mg)}}$$

Statistical analyses

Before conducting further analysis, the experimental data underwent a check for homogenization of deviations using the Bartlett exam and the Kolmogorov-Smirnoff test for normalcy.

A three-way ANOVA was used to examine the depredation parameters, namely rates of growth and conversion percentages. Tukey's post hoc analysis of means was used to examine the various rearing circumstances (ideal, plentiful, and scarcity) for several spider varieties. [4-6] prey species, and their interactions as independent factors. The statistical program used for all statistical analyses was Minitab 16 (Minitab Inc., State College, Pennsylvania, USA).

Results and Discussion

Influence of fluctuating prey-specific resources on the development rates in four varieties of wheat field-dwelling arachnid (F-values important at $P < 0.05$; data are Mean $\pm$ SE; varying letters indicate meaningful variances)

Experimental conditions	Spider species	Sitobion avenae (Prey) — Wingless	Sitobion avenae (Prey) — Winged
Scarce	Oxyopes javanus	0.10 $\pm$ 0.00cB β	0.04 $\pm$ 0.00cB α
	Pardosa sumatrana	0.05 $\pm$ 0.00bA β	0.02 $\pm$ 0.00bA α
	Tetragnatha javana	0.06 $\pm$ 0.01cA β	0.03 $\pm$ 0.01cA β
	Neoscona theisi	0.11 $\pm$ 0.01cB β	0.05 $\pm$ 0.01bB α
Optimal	Oxyopes javanus	0.05 $\pm$ 0.01bC β	0.02 $\pm$ 0.00bB α
	Pardosa sumatrana	0.01 $\pm$ 0.00aA α	0.01 $\pm$ 0.00aA α
	Tetragnatha javana	0.02 $\pm$ 0.00bB β	0.01 $\pm$ 0.00bA α
	Neoscona theisi	0.08 $\pm$ 0.01bD β	0.04 $\pm$ 0.01bC α
Abundant	Oxyopes javanus	0.02 $\pm$ 0.00aB β	0.00 $\pm$ 0.00aA α
	Pardosa sumatrana	0.01 $\pm$ 0.00aA α	0.01 $\pm$ 0.00aB α
	Tetragnatha javana	0.01 $\pm$ 0.00aA β	0.00 $\pm$ 0.00aA α
	Neoscona theisi	0.04 $\pm$ 0.01aC β	0.01 $\pm$ 0.00aB α
Three-way ANOVA	Experimental condition (E)	F=145.92; $P < 0.0001$; df = 2, 239	
	Spider species (S)	F=59.64; $P < 0.0001$; df = 3, 239	
	Prey variants (P)	F=157.97; $P < 0.0001$; df = 1, 239	
	Interaction (E $\times$ S $\times$ P)	F=0.42; $P = 0.866$; df = 6, 239	

The results corroborate prior studies, indicating that disparities in the Metabolic differences, prey capture techniques, the length of time spent eating on the victim, but and variations in prey size may all be linked to patterns of usage, redevelopment, and developing rate between the four arachnid species [6-7]. The web-building T" is associated with each of the insect pests of rice. Javana and the terrestrial predator P. sumatrana exhibited significantly reduced eating efficiency patterns. The user's text is a single letter, "O". Javanus exhibits a rapid attack rate and a brief duration for handling prey [8-9] suggesting a potential for increased prey consumption and growth rate. [3] and web-building spiders [4] however, exhibited a reduced rate of capturing prey. Consequently, web-building spiders consume a smaller amount of food, but they do it with great efficiency, thus overcoming the constraint of a lower rate of prey consumption. The findings demonstrated that all four spider species had greater conversion efficiencies and growth rates when prey was sparse compared to when prey was abundant and ideal. The conversion and growth rates shown a considerable increase for the wingless stage, which was preferred, compared to the phase of insects with wings. The findings showed that each of the four spider taxa' attack traits [8], when the settings were changed from their normal ad libitum prey rearing state to a situation with limited prey. Conversely, the predatory characteristics diminished when they were removed from their freely available feed to the plentiful prey rearing setting. This behavior is not observed when prey is abundant or ideal. Prior studies have already documented comparable outcomes, with enhanced conversion efficiencies and growth rates observed in coccinellid beetles in conditions of limited prey availability [5-6].

Conclusion

Spiders had the most rapid rates of expansion when feeding on abundant populations of insect pests that infested rice crops. The four-tarantula species' varying patterns of consumption, conversion, and maturation rate may be attributed to variations in their physical features, food acquisition techniques, length of prey eating, and prey size.

The findings revealed that all four kinds of spiders had better development rates in the given settings of limited prey availability, as opposed to when prey was abundant and optimal. Under ideal and plentiful circumstances, all four spider species exhibited a clear preference for consuming wingless wheat aphids rather than winged ones. The wingless morph of aphids, which is favored, demonstrated notably superior conversion and growth rates in comparison to the winged morph.

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