Wolf spiders are generalist predators that exist in many agricultural systems. Communities of wolf spiders are comprised of a variety of species and may occur in patches of varying density and composition. We conducted a field study using three commonly occurring wolf spiders, Pardosa milvina, Trochosa ruricola, and Rabidosa spp. with soybeans as our model agricultural plant. Nine treatments were created by planting the soybeans during the summer growing season within enclosures with different wolf spider communities. The treatments were: 1) Rabidosa only, 2) Pardosa only, 3) Trochosa only, 4) Pardosa and Rabidosa, 5) Rabidosa and Trochosa, 6) Trochosa and Rabidosa, 7) no enclosure, 8) no spiders, and 9) Pardosa, Rabidosa, and Trochosa (N=17 treatment). Enclosures were checked on a weekly basis and stem and leaf measurements taken. The presence of spiders was recorded, and any non-treatment species were removed. Plants were harvested at the end of the summer and leaves, pods, and root nodules were counted and plant biomass was weighed. Spider treatments were not shown to have a significant impact on the final plant biomass, although number of leaves, Mass, and stem length may have been an interaction between the number of pods produced by soybean among treatments.

Introduction

Herbivory can be costly to plants because it removes valuable photosynthetic material that would otherwise be used to support growth and reproduction. This is especially important within the agricultural industry, which loses millions of dollars every year to herbivory. Pesticides are often used to reduce herbivory in agroecosystems, but growing concern for environmental safety has led to an increased interest in non-chemical remedies for pest reduction. One promising alternative is the use of biological control agents (Googe 2004). Members of the cursorial non-web building wolf spider family Lycosidae are often the dominant predatory arthropods in agricultural ecosystems (Samu et al. 2003), and thus are a good candidate for biological control measures. They are generalist predators that impact populations of many insect species within arthropod communities. Wolf spiders have the potential to indirectly impact crop production through reductions in herbivory. The presence of natural enemies, such as wolf spiders, suppresses pest species through predation and chemical cues left in the environment.

We conducted a field study using three commonly occurring wolf spiders, Pardosa milvina, Trochosa ruricola, and Rabidosa spp. with soybeans as our model agricultural plant. Nine treatments were created by planting the soybeans during the summer growing season within enclosures with different wolf spider communities. The treatments were: 1) Rabidosa only, 2) Pardosa only, 3) Trochosa only, 4) Pardosa and Rabidosa, 5) Rabidosa and Trochosa, 6) Trochosa and Rabidosa, 7) no enclosure, 8) no spiders, and 9) Pardosa, Rabidosa, and Trochosa.

Hypothesis 1: Presence of spiders will decrease leaf damage and increase seed yield via both direct (consumptive) and indirect (chemical cues associated with predator presence) effects on plant herbivores.

Wolf spiders leave silk draglines as they move around the environment, which serves as chemical cues detectable by insect herbivores as well as other wolf spiders (Bardack & Googe 2002, Hitchvico & Rysptra 2003). The impacts of wolf spider communities on the ecosystem may depend on the species composition due to differences in size, preferred habitats and periods of activity (Marshall et al. 2001). Adult spider predation could result in increased intraguild predation and cannibalism, and therefore decrease effectiveness of spiders as biocontrol agents.

Hypothesis 2: Multiple predator species will be more effective at controlling herbivore damage because they will show greater exploitation of available niches.

Although there was some observational evidence of niche utilization in that Trochosa was much more commonly burrowed into the substrate, differences between treatments did not reflect a significant reduction in herbivory. These treatments containing a more diverse assemblage of wolf spider species showed no decrease in herbivory.

Hypothesis 3: Within the treatments containing more than one spider species, intraguild predation should lead to reduced numbers of the smaller spider species.

The Pardosa milvina treatments were strongly affected by the presence of Rabidosa, showing significantly fewer adults in treatments with Rabidosa. This impact was not shown in the treatment also containing Rabidosa (zero) was significantly different from the number of adults in the Pardosa only treatment (p = 0.004). In treatments where all three species were together, adult Rabidosa numbers were also significantly reduced relative to the Rabidosa only treatment. Adult Rabidosa numbers did not show the same level of affect, perhaps because their size is below that which larger predators such as Rabidosa can comfortably take. Adult Rabidosa numbers did not decrease due to the presence of the other species. Adult Trochosa numbers were significantly reduced when in treatments with Rabidosa.

Hypothesis 4: The threat of intraguild predation and cannibalism can cause spiders to exhibit antipredator behavior, compromising feeding efficiency of spiders and resulting in lower body condition.

The density of spider populations in a limited area may also negatively impact body condition.

In addition to the effects that wolf spiders may have on insect herbivores, they also have many potential intraguild predator–prey interactions between members of Lycosidae. The presence of additional spider species may interfere with insect prey capture directly through competition or indirectly through increases in antipredator behavior that result in decreased feeding. Spiders within the enclosure is limited, in a field setting the wolf spiders would have much more space to move through. As populations within the enclosure is limited due to reproduction and the hatching of spiderlings, intraguild and conspecific competition may increase, resulting in reduced body condition.

Results

Plant biomass was not significantly impacted by the spider treatment or presence within the enclosures. Treatments were maintained throughout the experiment. The spider species collected at the end of the harvest period were: Microbomus orientalis, Protobolus viviparus, and Synema spp. with soybeans as our model agricultural plant. Nine treatments were created by planting the soybeans during the summer growing season within enclosures with different wolf spider communities. The treatments were: 1) Rabidosa only, 2) Pardosa only, 3) Trochosa only, 4) Pardosa and Rabidosa, 5) Rabidosa and Trochosa, 6) Trochosa and Rabidosa, 7) no enclosure, 8) no spiders, and 9) Pardosa, Rabidosa, and Trochosa.

Hypothesis 4: The threat of intraguild predation and cannibalism can cause spiders to exhibit antipredator behavior, compromising feeding efficiency of spiders and resulting in lower body condition.

The density of spider populations in a limited area may also negatively impact body condition. Pardosa milvina final populations showed a strong interaction between the treatment and the final spider populations (Figure 2).

Figure 1 – A subset of the 142 enclosures in which soybean were planted and various spider communities were added.

Figure 2 – The effect of treatment on final number of soybean nodules. Hypothesis 1 was found to be significant for the model (p < 0.005). Figure 3 shows a significant interaction between the total spider density in the enclosures and the body condition of Pardosa milvina. As the density of spiders increases, the body condition is reduced. Pardosa milvina body condition was also significantly impacted by treatment, with the worst body conditions in those treatments containing Rabidosa. Body condition was found to be significantly better in the PT treatment compared to the treatment containing only Pardosa (p = 0.0311).

References


Prior to weighing, all plant material was dried for a minimum of 48 hours to ensure the absence of moisture. All data was entered into an Excel document and analyzed using SPSS.

Figure 3 – Pardosa milvina body condition, as measured by the cephalothorax to abdomen ratio (p < 0.0001). Body condition decreases with increasing intraguild predation pressure. Cephalothorax width depends on maturity status and size, while abdomen width is dependent on sattiation level. The lower the C/I value, the larger the abdomen is in proportion to the cephalothorax.