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WHY A SYMPOSIUM ON SPIDERS IN AGROECOSYSTEMS NOW?

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Our goal in organizing this international symposium was to bring together active workers to summarize what we know of the individual, population, and community ecology of spiders in agroecosystems, and to suggest how that knowledge can be used to increase the efficacy of spiders as biological control agents.

There are at least three reasons why this is an opportune time to hold the present symposium. First, there is an urgent need, and a general climate of acceptance, for the use of biological control agents in insect pest management. Second, there is ample rigorous experimental evidence that spiders *can* be effective in suppressing pest populations and improving crop health and productivity. Finally, spiders *have been* effectively incorporated into one of our important pest management systems.

Need: Despite some narrowing in the disparity between birth and death rates (Bongaarts 1998), the human population continues to grow beyond its present six billion, which already strains the ability of agriculture to provide for its food and fiber needs. The food necessary to support our growing population will have to come from increased yields on land already under cultivation (Brown 1995; Daily et al. 1998). Leveling off of crop yield increases worldwide suggests that physiological limits to photosynthesis, and to photosynthate allocation to edible plant parts, are being approached (Brown 1998; Calderini & Slafer 1998). It will take great ingenuity to increase the efficiency of use of inputs (mechanical energy, fertilizer, water, pesticides and other pest management tools, crop and livestock genetic diversity) while reducing environmental and social costs (soil erosion and salinization, lowering of water tables, soil and water pollution, loss of biodiversity, development of pesticide and antibiotic resistance) (Daily et al. 1998).

Each agricultural discipline has a role to play in the optimization of variables affecting food availability. As ecologists who study a group of obligate insectivores, arachnologists' obvious arena is pest management. More than 600 arthropod pest species regularly take more than 10% of our agricultural production (Samways 1997). Total reliance on synthetic chemical pesticides for pest suppression entails many severe and costly health, environmental, and even pest management side effects (Newsome 1970; Kaaya 1994; Pimentel et al. 1992). Genetic engineering of crops is not a magic bullet to solve this problem. The most widely touted approach, insertion of microbial insecticidal genes into crop plants, requires complex region-wide management schemes to ensure its sustainability (Gould 1998), and it is being broadly resisted by environmentalists.

The insecticide crisis has led to a broader acceptance of Integrated Pest Management (IPM), including the addition or enhancement of natural enemy populations (Andow & Rosset 1990). Insect natural enemies, particularly parasitoids and pathogens, are well-recognized components of IPM programs. Spiders, despite their ubiquity and high densities (Dondale 1970; Turnbull 1973; Nyffeler & Benz 1987), have not received the recognition they need in order to be fully utilized in this enterprise, although their treatment in several recent compendia is encouraging (Toft & Riedel 1995; Booij & den Nijs 1996; Powell 1997; Barbosa 1998).

Evidence for potential effectiveness of spiders as biological control agents: Many field experiments, performed over the last 35 years, have demonstrated that spiders can reduce insect populations and the crop damage they cause (Itô et al. 1962; Mansour et al. 1980; Mansour & Whitcomb 1986; Mansour 1987; Oraze & Grigarick 1989; Riechert & Bishop 1990; Carter & Rypstra 1995; Riechert & Lawrence 1997). At least one of these experiments contains implicit, applicable protocols for increasing vegetable productivity by altering the microhabitat at the soil surface to make it more attractive to spiders (Riechert & Bishop 1990).

Spiders have been incorporated into one important pest management system: An abundant wolf spider, *Lycosa (Pardosa) pseudoannulata*, is among the arthropods counted by rice farmers in the FAO Intercountry Programme for Integrated Pest Control in south and southeast Asia when they make management decisions for brown planthopper and other insect pests (Stone 1992). One reason this program has been so successful is that farmers learn its worth by performing field experiments (Ooi 1996).

Organization of the symposium.—We devised a framework to enable us to get from basic ecological principles to the enhancement of the role of spiders as biological control agents. A few subject areas had to be omitted due to other commitments of potential contributors. With these few exceptions, we believe we were able to touch on most of the important principles and applications. Surprisingly, some of the most important questions either had not been examined or had only been cursorily examined before. We therefore had to challenge some of our colleagues to take on topics for which the conclusions were not obvious in advance. That these efforts produced a number of startling and provocative insights is a source of great satisfaction to us.

To ensure rigor and completeness, all papers were subjected to external peer review by leaders in their fields.

Coda.—Agroecosystems, though mind-numbingly complex, are simpler than most natural ecosystems and more amenable to experimental manipulation. Therefore they are convenient and tractable outdoor laboratories for invertebrate ecologists. Furthermore the existence of data, methodologies and models concerning pests and natural enemies obviates the need for much initial groundwork. We encourage more ecologists to work in these important systems.

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