Ecology of entomopathogenic fungi in agroecosystems

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Category: Agricultural and Biological Sciences > Agricultural and Biological Sciences (miscellaneous), Agronomy and Crop Science, Insect Science

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Synopsis

Fungi that infect insects have received considerable attention by scientists for their potential for biological control of pests. Many research projects have focussed on the selection of virulent strains for target pests and their development as biological control agents. In contrast, surprisingly little is known about the fundamental ecology of most of these fungi in nature. This knowledge is essential in order to receive the most ecosystem services provided by entomopathogenic fungi in agricultural production. Knowledge of the basic ecology of the fungi is also necessary to include them in conservation biological control. In this biological control strategy, agricultural practices and/or habitat manipulations are applied to the farming system to favour living conditions for specific natural enemies of pests (Eilenberg et al., 2001).

Entomopathogenic fungi are widespread in agroecosystems. In temperate regions taxa from the phylum Ascomycota (order Hypocreales) and the subphylum Entomophthoromycotina (order Entomophthorales) are commonly found to infect arthropod hosts. The hypocrealean species *Beauveria bassiana* and *Metarhizium anisopliae* have broad host ranges in agroecosystems. Recent research advances have elucidated aspects of the ecology of the fungi that are relevant for conservation biological control. It is suggested that only *B. bassiana* are associated with insect hosts above ground while *M. anisopliae* is exclusively associated with hosts on or below the soil surface in temperate agroecosystems (Meyling & Eilenberg, 2007). However, the reservoir of both fungi in the ecosystem is within the soil environment (Keller & Zimmermann, 1989; Meyling & Eilenberg, 2006) and both taxa can be isolated from the same soil sample.

Applications of DNA based markers have revealed new insights especially for the genus *Beauveria*. Main conclusions are that the genus contains cryptic species that do not reflect the morphologically defined species as conventionally defined (Rehner & Buckley, 2005). Thus, much more is to be learned about *Beauveria* spp. as defined by phylogenetic species. Differences in ecological niches of the taxa within *Beauveria* remain unclear, but the new explicit phylogenetic framework creates a basis for detailed studies of this in the future. For example, five different clades of the morphological species *B. bassiana* were isolated within a single agroecosystem in Denmark (Meyling & Eilenberg, 2007). However, only one of these was found in agricultural soil while all five were represented in the semi-natural habitat of the bordering hedgerow. Therefore it appears that more niche space is available in hedgerows for the fungi. If these can be identified and understood it may be possible to manipulate the agricultural field to host more clades and thus more diversity of entomopathogenic fungi for pest control. Furthermore, the recent development of microsatellite markers (Rehner & Buckley, 2003; Enkerli et al., 2005) will surely provide new insights in the population ecology of *B. bassiana* and *M. anisopliae* within the coming years.

Some entomopathogenic fungi are not only associated with arthropod hosts. Recently, *B. bassiana* has been linked to plants as an endophytic fungus (Arnold & Lewis, 2005), and *M. anisopliae* has been shown to be associated with the rhizosphere of plants (Hu & St.Leger, 2002). The ecological significance of these associations remain unknown, but they have been discussed within the concept of the "bodyguard hypothesis" (Elliot et al., 2000). Several crop plant species have been shown to be successful hosts of endophytic *B. bassiana* and the occurrence of the fungi in the plant tissue may benefit control of chewing insect herbivores.

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