Available online at www.sciencedirect.com
SCIENCE DIRECT®
ELSEVIER
Applied Soil Ecology 31 (2006) 147–158
Applied Soil Ecology
www.elsevier.com/locate/apsoil

Diversity of soil mite communities when managing plant communities on set-aside arable land

Dagmar Gormsen [a], Katarina Hedlund [a,*], Wang Huifu [b]

[a] Department of Ecology, Ecology Building, Lund University, S-223 62 Lund, Sweden
[b] Institute of Zoology, Academia Sinica, Beijing, China

Received 9 July 2004; received in revised form 2 March 2005; accepted 7 March 2005

Abstract

When restoring former agricultural land to more low-nutrient input ecosystems, the establishment of a plant community can be enhanced by sowing desirable species. In this study our aim was to determine whether management of the plant community influences the microarthropod community. We carried out a field experiment in three European countries on set-aside arable land and determined soil mites from the sites in Sweden, The Netherlands and Spain. Experimental plots on set-aside arable land were sown with high (15 species) or low (4 species) plant species seed mixtures; other plots were colonized naturally. A field with continued agricultural practices and a later successional site (target site) were used for comparison with the experimental plots. Soil from the later successional site was inoculated into half of the plots. Abandoning agricultural practices increased the density of mites at one site while the number of mite species was not affected. Sowing plant seeds had no effect on mite densities at any of the sites. The community composition of mites changed in response to management of the plant community, as shown by canonical correspondence analysis. Among the functional groups of mites, saprophytes generally dominated on all plots at all sites. Mites parasitic on insects were not present on fields with continued agricultural practice in Sweden and The Netherlands, and might thus be regarded as an indicator of an increase in trophic complexity in the sown and naturally colonized treatments. Predatory and plant parasitic mites showed no consistent pattern in relation to the treatments of the three sites. Soil inoculation treatment had only a minor impact on the soil mite communities.

Keywords: Land use change; Recolonisation; Functional groups; Microarthropods

1. Introduction

The transition of an arable soil to a later successional soil such as a grassland or a forest includes changes not only in the composition of conspicuous plants but also in soil fauna and microbial communities. Abundant taxonomic groups, such as soil collembolans, will be found in both arable and forest soils, but the species composition will differ (Persson, 1983; Hansson et al., 1990). Microarthropods are generally more abundant in undisturbed soils than in conventionally managed arable soils (Petersen and Luxton, 1982; Hendrix

* Corresponding author. Tel.: +46 46 2223798; fax: +46 46 2224716.
E-mail address: katarina.hedlund@zooekol.lu.se (K. Hedlund).

0929-1393/$ – see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.apsoil.2005.03.001

et al., 1986). When changing from high-nutrient input agricultural practices to low-nutrient input set-aside land, the species composition of the whole soil community will change, as it is correlated with the amount of organic matter present in the soil (St. John et al., 2002). Decomposition processes will be channelled from the bacterial towards the fungal community (Moore and de Ruiter, 1997; Grayston et al., 2004), and this possibly will affect composition of soil organisms feeding on microorganisms.

The change in the soil faunal community involves colonization of new species in parallel with changes in the relative abundance of resident species. The biodiversity of mites is known to increase over long time periods since abandonment of high input agriculture, since there will be an addition of drought sensitive species in later successional stages (Scheu and Schultz, 1996; Siepel, 1996). A halt to cultivation or tillage of soil will also increase mite abundance and species number considerably even within short time periods such as one or two growing seasons (Purvis and Curry, 1980; Emmanuel et al., 1985; Minor et al., 2004).

By feeding on litter and other organic matter and by dispersing microorganisms soil microarthropods interact with microbial decomposers and thus have an impact on plant communities (Visser, 1985; Visser et al., 1987; Schaefer, 1990; Beare et al., 1992). The influence of soil microarthropods on plant species composition and succession have received less attention but recently it has been shown that the soil invertebrate fauna can enhance grassland succession and plant diversity by suppressing early successional species that otherwise dominate the plant community (De Deyn et al., 2003).

Within the frame of an EU research programme we carried out field experiments at sites where management practices were studied to increase the rate of change from former agricultural land to more natural and diverse ecosystems (Van der Putten et al., 1999). These management practices increased the rate of transition of the plant community towards later successional stages (Leps et al., 2001). Changes in the plant community composition were also reflected over relatively short time periods in the microbial community but not in nematode and earthworm communities (Hedlund, 2002; Hedlund and Gormsen, 2002; Hedlund et al., 2003).

The aim of this paper is to elucidate how such management practices and subsequent changes of the plant community also influence the below-ground microarthropod community composition. Within the EU project CLUE (Changing land use: enhancement of biodiversity and ecosystem processes) a field experiment was performed in three European countries to determine whether (1) sowing of later successional plant species can increase rates of succession of soil mites in former agricultural land and (2) soil inoculations from a later successional stage can enhance the development of a later successional soil mite community.

2. Materials and methods

2.1. Field sites

Experimental plots were established on abandoned agricultural fields in South Sweden (SE), The Netherlands (NL), Spain (SP), the United Kingdom and the Czech Republic but only data from the first three sites are used here. The Swedish site was located close to Lund (S Sweden) and the soil was a clayey till with pH 5.8 (KCl). The Dutch site was located in the South East of The Netherlands (Mossel) and was a sandy loam, pH of 5.8 (KCl). The Spanish site was located close to Salamanca and was a loamy clay with a pH of 7.3 (KCl). The average temperature was 10.8 °C in Spain, 9.4 °C in The Netherlands and 7.5 °C in Sweden. The average precipitation was 500 mm/year in Spain, 840 mm/year in The Netherlands and 700 mm/year at the Swedish site. More data on locations of field sites, climate, soil nutrients and plant species sown are reported in Hedlund et al. (2003) and not described here in detail. The fields were set aside in 1995 and a randomized block design was used for three sowing treatments with an additional factor of soil inoculation applied on each treatment. A total of thirty plots (2 m × 2 m in Spain and in The Netherlands, 4 m × 4 m in Sweden, with 2 m borders between the plots) were installed, with each combination of plant and soil treatment being replicated five times. The sowing treatments were: (1) high plant diversity (15 species sown: 5 grasses, 5 forbs, 5 legumes); (2) low plant diversity (4 species sown: 2 grasses, 1 forb, 1 legume species); (3) natural colonization (no plants