

Effect of conservation practices on functional diversity and assembly of weed communities: a database of functional traits

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Abstract

This work shows the approach used for the construction of a database of weed functional attributes aiming to study the effect of conservation practices in organic arable cropping systems, taking into account both the potential detrimental effects of weeds on crop yield and their ecological services. The database of functional traits includes ca. 250 weed species recorded in 13 on-going European trials, including long, mid and short-term experiments, with reduced tillage and green manures as main factors. The information of the database should help to understand the role of conservation practices in shaping functional attributes of weed communities and to predict the management-induced changes.

Introduction

The incorporation of conservation agriculture techniques (e.g. reduced tillage and green manures) in organic farming brings many benefits to the environment and reduces energy use. One of the main drawbacks of the use of reduced tillage is the potential increase in weed infestation and shifts in the weed community composition, sometimes to the benefit of more difficult-to-control species (Sans et al. 2011). However, weeds have an important role in maintaining farmland functional biodiversity (Bàrberi et al. 2010). In 2012 we started a study with the aim of evaluating the effects of conservation agricultural methods on functional attributes of weed communities, taking into account the potential detrimental and beneficial effects of weeds. Knowledge on the outcome of positive and negative effects will be useful in the context of evaluating soil conservation practices. In this paper we highlight the approach used to build the weed functional traits database, the first step in this study.

Material and methods

The study uses the information on the weed flora of 13 existing trials within the framework of the European project TILMAN-ORG, including 5 long-term trials (> 7 years), 4 mid-term trials (3 to 7 years) and 4 short-term trials (< 3 years) with reduced tillage and green manure as main factors. The partners are: CIRAA and SSSA (Italy), CRP-GL (Luxemburg), EULS (Estonia), FiBL (Switzerland), FiBL AT Austria, ISARA (France), ORC (the United Kingdom), UB (Spain), WIZ (Germany) and WUR-APR (the Netherlands).

The analysis of the effect of conservation practices on the functional traits and assembly of weed communities has been carried out with a step-by-step process. The first step was the development of a database of functional traits which included all the species recorded in the different trials. Seventeen traits were selected, some of them indicators of potentially troublesome effects from an agricultural point of view (Raunkiaer's life-form, growth form, Grime's CSR strategy, lifespan × regeneration form, seed bank longevity, seed weight, canopy height, specific leaf area, beginning and duration of flowering, seasonality of germination) and other indicators of potentially ecological services (support of beneficial arthropods and pollinators, support of arbuscular mycorrhizal fungi, atmospheric nitrogen fixation, root system) or dis-services (support of crop pests and pathogens). Species affinity to soil nutrient conditions and their conservation value (National Red list species) were also taken into account.

Results

A database of ca. 250 weeds was developed, which includes the complete list of weed species found in the 13 on-going field trials. Information on functional traits was obtained from several open access databases such as Bioflor (Kühn et al. 2004), Banc de Dades de Biodiversitat de Catalunya (Font 2013), Ecological

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Flora of the British Isles (Fitter et al. 1994) and LEDA Traitbase (Kleyer et al. 2008). Information on detrimental and beneficial arthropods and pathogens were obtained from the Ecological flora of the British Isles, the United States Department of Agriculture, the University of Davis, the Fungal Records Database of Britain and Ireland, the Natural History Museum of the United Kingdom and several web pages for agricultural consultants are available worldwide. Peer-reviewed literature (e.g. Pignatti et al. 2005) and floras (e.g. the Flora Europaea) were also used to highlight functional attributes.

The next step after compilation of the weed functional traits database will be to assess whether conservation practices (i.e. reduced tillage and green manures) affect functional traits of weed communities. Availability of a large number of experiments, some of them running for a long period, and from different climatic areas of Europe is an excellent opportunity to study the role of conservation practices in shaping functional attributes of weed assemblages, and may help us to predict management-induced changes in weed communities and their expected consequences.

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