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Getting the Most out of Cover Crops

An online toolbox for cover crops and living mulches

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Summary

Cover crops and living mulches form an integral component of conservation agriculture promoting soil health and minimising external inputs. The OSCAR Project (Optimising Subsidiary Crop Applications in Rotation) aims to improve practices of conservation agriculture in farming systems across Europe. The principal output of the project is to develop a toolbox to make technical and scientific information publically available to farmers, researchers, and other stakeholders. The continually evolving toolbox is currently available online at www.covercrops.eu and will consist of three facets (1) An interactive user-fed wiki providing information on subsidiary crops species and machinery use with links to published literature; (2) A searchable database on subsidiary crops and technology. This will detail climatic and soil specific plant traits and will form a decision support tool to aid choices of subsidiary crops; (3) A discussion forum will also facilitate the exchange of information between farmers, researchers and stakeholders on conservation agricultural systems across European countries.

Key words: Subsidiary crops, cover crops, living mulches, conservation agriculture, online toolbox

Introduction

There is an ever increasing need to advance the sustainability of farming systems by improving the quality and structure of soil whilst maintaining productivity. Conservation agriculture (CA) aims at reducing soil disturbance and exposure as well as integrating subsidiary crops as living mulches or cover crops with main crops in rotations to address these challenges to soil conservation by increasing the duration of soil coverage over the rotation, enhancing biological fixation of nitrogen and mitigating the use of agrochemical inputs as well as delivering multiple ecosystem services including increased species diversity and regulation of water run-off and demand.

CA practices, including minimum- and no-tillage, have increasingly been successfully employed in conventional farming systems achieving long-term benefits to soil quality and reduced production costs (Holland, 2004). However, these practices rely heavily on the use of herbicides to control weeds and have meant that reduced tillage has been difficult to implement effectively in organic farming systems where ploughing is often the primary method of weed control. Effective use of subsidiary crops to control weeds in reduced tillage systems is essential to implementing CA in organic systems and may further mitigate the use of herbicides in conventional reduced tillage farming systems.

The adoption of CA practices and use of subsidiary crops is often limited by lack of knowledge of species applications, management and integration within arable rotations. Performance of subsidiary crops has also been shown to be site specific and highly dependent on soil type and regional climates (Döring *et al*., 2013). This has meant that farmers and practitioners face challenges when making informed decisions regarding choice of cover crop or living mulch species and varieties which are currently commercially available. There are also a great deal of potential novel and underutilised subsidiary crop species which may be adaptable to UK climates and CA farming systems but are not yet commonly used (Baresel & Reents, 2008).

The EU funded OSCAR (Optimising Subsidiary Crop Applications in Rotation) project is a collaborative project involving 20 partners across nine European countries which aims at trialling CA practices across a range of farming environments and systems (Baresel *et al*., 2012). A primary output of the project will be a comprehensive, publically available knowledge base (Cover Crop and Living Mulch Toolbox) The Toolbox will contain a number of user interactive elements which will allow it to continually develop and evolve after the lifetime of the project. This approach will help address the fragmentation of existing knowledge by consolidating information in a central, user-friendly environment. The following paper gives an overview of the toolbox describing its three main components and their functions.

Fig. 1. A screen shot of the homepage of the toolbox taken on 18 Feb 15.

The Cover Crop and Living Mulch Toolbox

The toolbox aims to provide a one-stop access point for information on cover crops, living mulches and CA technologies for a wide range of relevant communities, ranging from farmers and advisers

to researchers, seed producers and plant breeders. The toolbox will soon be publically available at www.covercrops.eu and is free of charge for users. Users will be able to access all components of the Toolbox from its homepage (Fig. 1) which consists of generic introductory texts serving as the welcome and motivation point, and will include a troubleshooting section for subsidiary crop application and a FAQ list.

Components of the Toolbox

Cover crops and living mulch wiki

A 'wiki' can be defined as an online database collaboratively developed by a community of users where all users are able to add and edit its content. This allows for continual modification and improvement of the wiki's content according to its users' needs. The wiki homepage outlines general information regarding approaches to using cover crops and living mulches as subsidiary crops in rotations and their potential benefits to arable cropping systems. The various types of soil tillage systems are also described. More detailed information on individual cover crop and living mulch species can be found on their individual wiki pages (Fig. 2) which includes a description of the species, it's distribution in Europe, it's benefits as a subsidiary crop, as well as growers experience and recommendations on best agronomic practice for cultivation. A simple high, low or medium scoring system is presented for each species for criteria such as nitrogen fixing, benefits for biodiversity, forage value, biomass and seed cost. References and links where further information can be found are included in the text and the bottom of the page.

Fig. 2. An example of the species page on the cover crop and living mulch wiki for Crimson clover.

Information on many subsidiary crop species has already been added to the wiki from participating project partners who have been carrying out multi-environment experiments and germplasm screening trials across Europe. However, users of the wiki are encouraged to sign up to contribute and edit material on the site. Guidelines on 'how to edit the wiki' are available on the left hand side menu. All pages will be translated into German, Spanish, French and Italian as well as English to aid exchange of knowledge among practitioners and researchers across European countries. Contributing to the wiki will be a valuable opportunity for researchers to disseminate findings from research and for practitioners and advisors to contribute anecdotal experience to a platform capable of reaching a wide and diverse audience.

Species and technology database

The database is a collation of relevant data on leguminous and non-leguminous cover crops, living mulches and their climatic and soil specific performance which includes information from published literature, existing databases and from experiments within the OSCAR project. This will be used to generate an online searchable decision support tool that can be filtered by specification of a set of simple performance criteria such as weed competiveness, nitrogen fixation or site specific performance such as pH range or winter hardiness which will allow users to generate a list of potentially suitable subsidiary crop species for their circumstances. These results can then be linked to the cover crop and living mulch wiki where more detailed information can be found.

The range of data present in the database can also be exploited in an investigative way to detect patterns in the ecology of subsidiary crop species and to identify crucial gaps in regions or environments where there is a lack of suitable species (e.g. species suitable for very dry arid areas or acid soils). This may be due to a lack of characterised species and/or a lack of data. Identifying these knowledge gaps will help identify future priorities for research and breeding. This kind of comparison may also then be useful to compile mixtures or combinations of species with complementary properties. The database may also prove useful for compiling mixtures of complimentary species. Further analysis of trends and relationships between two or more plant traits can be carried out to investigate the relative importance of potentially useful traits on, for example, weed suppression (Fig. 3).

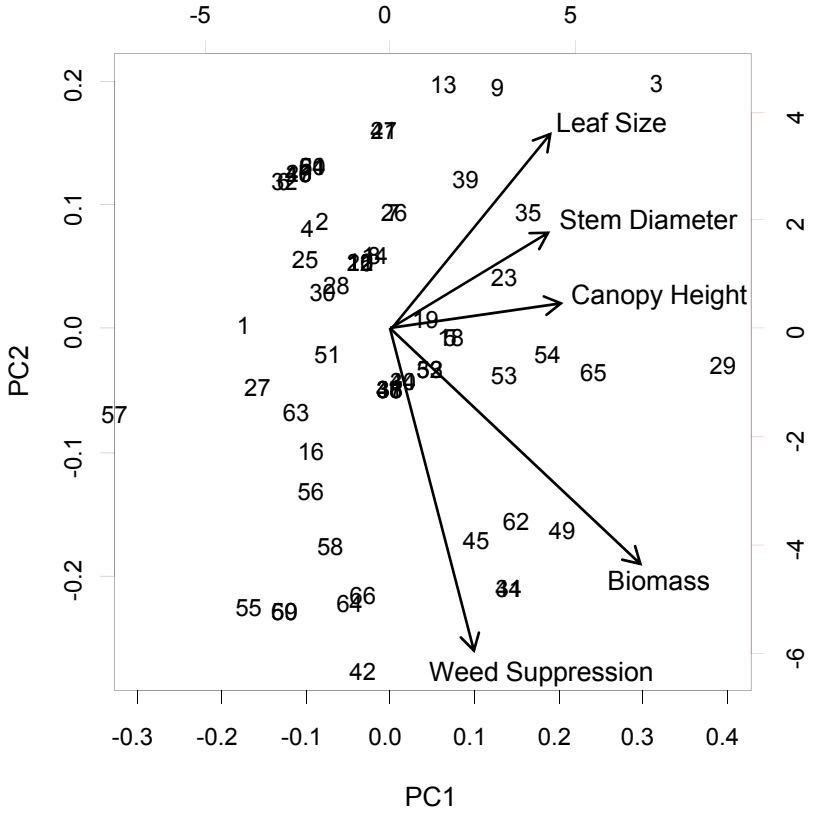

Fig. 3. Biplot of the first and second principle components of plant traits of 66 subsidiary crop species represented by numbers. Arrow vectors indicate scaled weighting of crop traits. Arrows pointing in the same direction indicate positive correlation; arrows pointing away from each other indicate negative correlation whist arrows at right angles indicate no correlation.

Discussion forum

From the Toolbox homepage users can access a general discussion forum allowing live feedback from users. This will provide a platform for discussions regarding cover crops, living mulches and machinery use. Participants will be able to share their experience and suggestions for what has and hasn't worked successfully. This approach will facilitate a central knowledge exchange amongst CA practitioners and enable dialogue between researchers and farmers.

Conclusions

The multifaceted OSCAR cover crops and living mulches toolbox is a mechanism not only to disseminate results and knowledge generated by the OSCAR project, but a platform for knowledge exchange between farmers, practitioners and researchers. Continued dialogue between research and practice is important to ensure the relevance and direction of research as well as making the latest research finding available to farmers in an accessible medium. The success of this user-interactive approach however depends upon the continued input of a sufficient number of both users and researchers. Development of CA practises will be strengthened by greater integrated communication among European groups where subsidiary crop research and innovations are fragmented and rarely communicated across the entire potential of international eco-climatic regions. Consequences of wider adoption of CA practices, such as a more diverse farming environment and improved soil management, will benefit the longer term environmental and productive sustainability of European farming systems.

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