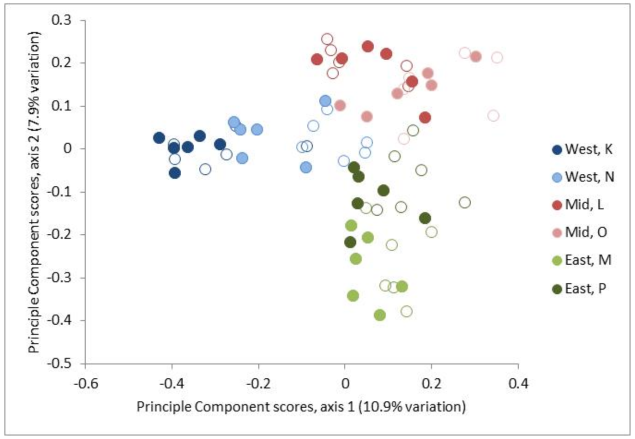
Ecological Indicators

The weed seedbank and surrounding field margins are the basis for in-field biodiversity. Total seed density was significantly affected by previous crop and management system. There was no effect of cropping system on species composition, which clusters by field location. This demonstrates a degree of resilience in the seedbank.



Principle component analysis of the seedbank community over the first 6 year rotation. Closed symbols = conventional; open symbols = sustainable, coloured by field

Emerged weeds and field margin vegetation support invertebrate food-webs, which provide a wide range of ecosystem services including predation, pollination and decomposition.
The invertebrate communities are monitored across the site by pitfall traps, pan traps and vortis suction sampling.

Conclusions

The CSC platform is a long-term experimental site and results will be made available on the project website (csc.hutton.ac.uk) at the end of each rotation. This information will be used, along with feedback from farmer groups, to improve on the sustainable cropping system in subsequent rotations.

Assessment of impact will be based on all key indicators of arable ecosystems and take account of the trade-offs between interacting components. In the long term, we predict an improvement in system function and resilience which should compensate for reductions in inputs of non-renewable resources, optimising both food production and system health.

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Scottish Government
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The Centre for Sustainable Cropping

A long-term platform for interdisciplinary research to optimise economic and environmental sustainability

The James Hutton Institute

csc.hutton.ac.uk

Introduction

The Centre for Sustainable Cropping (CSC) is a long-term experimental platform, established in 2009 at Balruddery Farm near Dundee, Scotland. The CSC integrates cross-disciplinary research on sustainability in arable ecosystems. The platform provides an open research facility to test and demonstrate the economic, ecological and environmental trade-offs in sustainable land management.

The CSC adopts a whole-systems approach for designing a sustainable arable cropping system that optimises yields, biodiversity and ecosystem services, whilst reducing the environmental footprint of crop production.

The long-term, whole-systems approach adopted at the CSC is essential if the potential conflicts between commercial and environmental interests are to be reconciled.



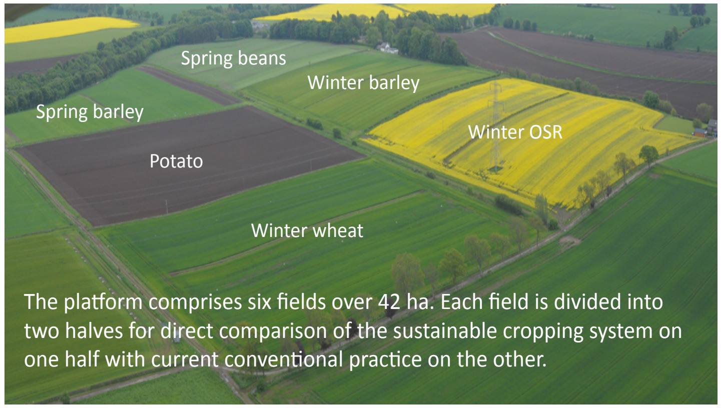
Objectives

1. Design and implement a cropping system to balance inputs and yield with environmental health, biodiversity and ecosystem processes
2. Apply a whole-systems approach to test the long-term impact on sustainability:
   - Ecological – enhanced biodiversity for provision of ecosystem services
   - Environmental – minimise losses through erosion, runoff, leaching and emissions
   - Economic – maintaining yield for economic sustainability, food security and health

The Sustainable Cropping System integrates:

- Conservation tillage/direct drill
- Tramline management
- Cover cropping
- Green waste municipal compost
- Straw incorporation
- Legume under-sowing
- Reduced rate mineral fertiliser/ renewable plant nutrient supply
- Threshold crop protection chemicals and IPM strategies
- Engineered riparian buffers
- Wildflower margins





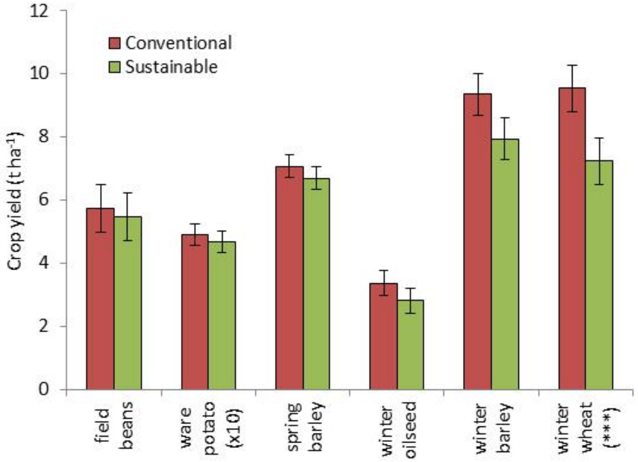
The platform comprises six fields over 42 ha. Each field is divided into two halves for direct comparison of the sustainable cropping system on one half with current conventional practice on the other.

Indicators of Sustainability

Economic Indicators

Yield, end product quality and sale price, offset against input costs, fuel use and tractor time are used to estimate financial margins.

Yield data from the first rotation show no significant effect of sustainable crop system in spring sown crops or winter oilseed rape, but there was a detectable yield penalty in the more intensively managed winter cereals.

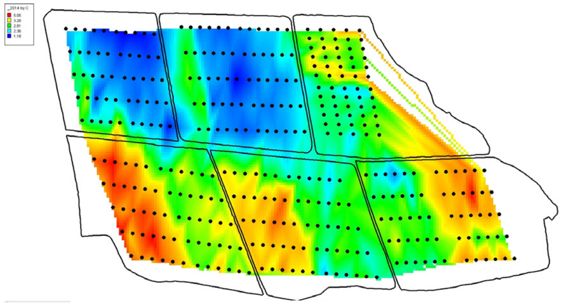


Crop yield averages for rotation 1

For the second rotation, the yield gap in winter cereals will be reduced by improving the efficiency of crop production, reducing losses and providing plant nutrients from renewable sources (e.g. waste digestates).

Environmental Indicators

Increased soil organic matter buffers the impact of non-inversion tillage on soil strength, and improves soil conditions over winter Losses of soil, plant nutrients and agrochemicals through greenhouse gas emissions, leaching and run-off are mitigated by improved soil structure, engineered buffers and cover cropping.



Soil organic matter content (loss on ignition at 400oC)