

Opportunities for cover crops in conventional arable rotations



Black mustard cover crop.

Always read product labels, consider your local conditions and consult a professional agronomist, if necessary.

Latest information

- Cover crops can bring agronomic and environmental benefits.
- Research is demonstrating improved soil characteristics and yields from the use of cover crops.
- Cover crops can be used in CAP Ecological Focus Areas and crop diversification.

Action

- Consider whether cover crops might offer benefits in your own farming system.
- Think about cover crop management and the use of mixtures to improve the benefits.
- Develop a long-term strategy for improving soils, weed control and crops on your farm.

What is a cover crop?

A cover crop is a non-cash crop grown primarily for the purpose of 'protecting or improving' between periods of regular crop production.

Cover crops can be used repeatedly as part of a long-term strategy to improve soil quality, organic matter and provide other benefits.

The duration of the cover crop can vary from a few weeks to several months or years, depending on the approach being used and the specific objective.

This Information Sheet focuses on autumn-sown cover crop use as an entry to spring cropping in conventional arable rotations.



Vetch.



Fodder radish.

Why use cover crops?

The active growth, rooting, ground cover and habitat provision afforded by cover crops can provide benefit in rotations over a bare fallow.

Cover crops can be used in arable rotations as a 'catch crop'. Providing cover at key times can help to reduce **nutrient losses** via run-off and leaching.

A cover crop can provide a 'green manure'; here, a cover crop will

return fresh organic material to the soil, which can increase soil biological activity, improving soil health and function.

Cover crops can also benefit soil physical and biological characteristics, leading to benefits in **soil structure**, potentially reducing erosion.

Cover crops can deliver agronomic benefits; for example, cover crops can help to perturb certain **pest and**

disease cycles or be used as part of wider **weed management** strategies. This can support and augment current on-farm practices.

Cover crops can also provide wider **habitat value** and give rise to options for livestock and supplementary feeding opportunities for wildlife.

General considerations

Aims: Different cover crops have contrasting properties, so it is essential to select an appropriate cover crop or species mix suited to the system and objectives. Cover crop choice needs to fit with farm practice, capabilities, expertise and available equipment.

Support: Cover crops can be used in Ecological Focus Areas of the Basic Farming Scheme and as options in agri-environment schemes, provided they comply with the rules.

Economics: Cover crop costs can vary markedly. The budget and likely costs/benefits should be considered for the following crop and the whole rotation. Cheap seed may be available on farm, eg oats and barley.

Management: Good crop establishment and growth are important to maximise benefit. As well as direct management of the cover crop, destruction and following-crop establishment should be considered.

Rotations: The cover crop species/mix selected will impact on other agronomic considerations in the rotation, eg disease carry-over, weed management, etc. Appropriate selection and management can help minimise and manage such rotational conflict.

Types of cover crops and potential components of mixtures

Mixtures

Cover crop mixtures are a commonly used approach. Different components of the mixture will deliver different benefits. A mixture also provides some risk management, as one species may do well when another does not.

When choosing a mixture (either preformulated or your own) there are few hard rules, but there are guidelines that can help. It is important to consider practicalities, such as management of variable seed sizes in mixtures, potential rotational conflicts and cost.

It is also important to consider how the components will complement each other:

- Growth: Is one component likely to out-compete another?
- Destruction: Are the life cycles and breakdown characteristics suitably matched?
- Objectives: Do the functional traits help to achieve the overall goal?
- Other crops: Are any of the components going to give problems in the following crops (eg volunteers) or wider rotational conflicts (with other crops or rotational intensity)?

Other options

The cover crop options below are not exhaustive and a wide range of options are available, such as phacelia, buckwheat and chicory. They have specific traits useful in certain circumstances; consult an agronomist for details.



Cover crops being drilled into stubble.

	Brassicas	Legumes	Grasses and cereals
Example species	Mustards, radishes, turnips	Vetch, clovers	Oats, rye, rye-grass
Benefits	Brassicas can grow rapidly in the autumn. There is a good understanding of brassica agronomy (from oilseed rape experience) and establishment systems tend to fit with farm equipment.	Legumes fix nitrogen, which can benefit following crops and raise fertility; the amount of nitrogen fixed depends on species, growth and temperature but is likely to be small with an overwinter cover crop.	Cereals and grasses can deliver good early ground cover (important where erosion is a concern) as well as other benefits, including vigorous rooting.
Characteristics	While there are many types and growth habits, autumn-sown brassicas often provide good ground cover and deep rooting. This can mitigate leaching risks and improve soil structure. Some have trap crop and biofumigant activity.	In addition to nitrogen fixing, like most cover crops, legume roots can help to improve soil structure; rooting will vary depending on species, field conditions and cover crop duration.	For autumn sowing, these species can establish quickly and some types offer a wider range of sowing timings than brassicas or legumes.
Sowing	They are often late summer-sown or early autumn-sown at similar timings to oilseed rape. Field conditions and variety should guide specific sowing dates.	Legumes tend to be slower growing than brassicas and, for autumn use, often need to be sown earlier (late July–August) to aid growth and promote nitrogen fixation.	Sowing times vary with species and may range from July through to September.
Considerations	Good autumn establishment is critical to maximise growth, particularly where soil structure or nitrogen capture are key objectives. Think about potential rotational conflicts, eg clubroot, where vegetable brassicas or oilseed rape are grown in the rotation.	Consider management around the sowing and establishment of small-seeded legumes (used alone or in mixtures). There are also potential rotational conflicts, especially where other pulses and legumes are grown in the rotation.	Management tends to be similar to autumn cereals and grasses. They may act as a green bridge for cereal pests and diseases.

The agronomy of cover crops

Sowing dates should be guided by the cover crop species/variety but good soil and seedbed conditions are more important than sowing date in achieving good establishment. Poor establishment often results from late sowing or low soil moisture.

Generally, autumn-sown cover crops tend to be sown from August to mid-September but some should be sown outside this window; for example, certain legumes benefit from early sowing.

Seed rates should be selected to reflect cover crop choice and field conditions. Where mixtures are used, reduce component rates compared to rates when used alone.

Establishment methods should be guided by cover crop choice, available equipment and field conditions. Seedbed rolling to conserve moisture and enhance seed/soil contact after sowing is often beneficial but the decision will depend on conditions. Uniformity of distribution is important. Where mixtures are being drilled, periodic mixing of seed in the drill can be useful.

Inputs will be influenced by the season and the cover crop; however, cover crops should be monitored and some autumn crop inputs and pest protection may be needed to gain maximum benefit. Mowing or grazing of some cover crops can also be beneficial.

Methods of destruction vary markedly and will depend on growth (canopy size and type of growth), available equipment and objectives. Autumn-established covers can be sprayed off with glyphosate early in the year, killed off by frost action, grazing or mechanically destroyed. This is often followed by spring incorporation prior to establishment of the following crop. In other scenarios, single pass drilling through residues is used. Where biofumigant or trap crops are sown there can be specific destruction requirements in order to attain the full benefits.

Long-term strategy: It should be recognised that cover cropping benefits are often not a quick fix and can take several cycles to accrue and become apparent.

Benefits of growing cover crops

Building soil fertility and organic matter: Cover crops can be used as green manures to add fresh organic material back to the soil. AHDB-funded research has shown that this improves worm numbers and microbial activity. In the longer term, regular use of cover crops can raise soil organic matter content.

Work undertaken within the NIAB TAG New Farming Systems programme has also demonstrated rotational yield and margin (over nitrogen) improvements from the use of specific cover crop approaches.

Cover crops can improve soil structure and retain nitrogen in the system. Cover crop type and growth will influence how much nitrogen is captured and when it is released, but Soil Mineral Nitrogen tests have shown greater availability to following crops.

Improving soil structure: Any cover crop with a vigorous root system can help open up soils, improving access to water and nutrients. Assessing soil structure helps select the right cover crop to address the underlying soil problems. For soils that would benefit from a more open structure at shallower depths (eg <20 cm), a range of cover crops may be beneficial, such as cereals, brassicas and legumes. For deeper soil

rectification, autumn-sown brassicas over the same period are potentially better suited.

Reducing soil erosion: Cover crops provide ground cover during risk periods for soil erosion by wind and/or water. Defra-funded research showed that cover crops sown early post-harvest reduce sediment loss from surface run-off over winter.

As a general guide, once more than a third to half of ground is covered, there is a substantial reduction in run-off and erosion risks. Useful species mixtures for this objective are those that will grow rapidly in the autumn and provide good ground cover, for example, oats and brassica mixes.

Weed and pest management: Some brassica cover crops have high levels of glucosinolates and, when incorporated, can inhibit some soil pests (eg nematodes). Certain cover crops (eg some *Solanum* species) can also promote egg hatch and reduce nematodes in following crops.

Cover crops may outcompete weeds. Some (eg rye and oats) also have a degree of allelopathic activity, potentially augmenting weed control. These effects, however, are small compared with the impacts of, for example, drilling date and cultivations.

The benefits of cover crops on weed control, especially grass weed control, have probably been overstated.

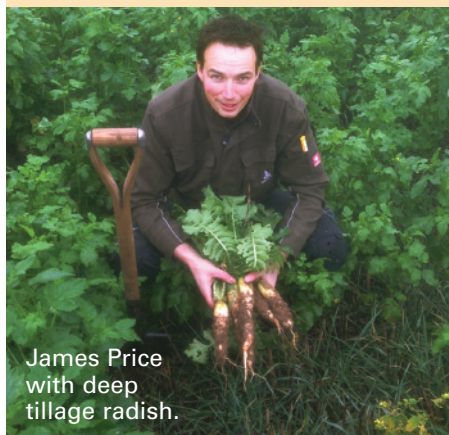
Creating habitat: Cover cropping provides winter cover and a habitat for wild birds, small mammals and insects and grazing opportunities for wildlife. The generation of predator habitat afforded through cover crops could augment pest management strategies.

Reducing nutrient loss: Defra-funded research shows that the uptake of nitrate by cover crops before the onset of winter drainage reduces nitrate leaching and losses of nitrates, ammonium and nitrous oxide (a greenhouse gas). Reduced soil run-off lessens the loss of phosphate attached to soil particles.

Improving water quality: Cover crops benefit the environment by reducing losses of sediment, nutrients and pesticides, which can impact on water quality and habitats. Soil run-off can lead to silting up of watercourses and high levels of nutrients in water bodies can cause algal growth and 'choking' of other aquatic life. Losses are more likely to occur in autumn and winter when soil moisture and rainfall levels are high. Cover crops help prevent nitrate leaching through the soil profile into watercourses or groundwater as the nitrogen is taken up by the cover crop.

Case studies

Name	James Price
Location	Oxfordshire
Size	650 ha
Soil type	Cotswolds brash
Rotation	Winter wheat, spring barley, winter oilseed rape, winter wheat and beans



James Price with deep tillage radish.

What was their objective?

James was interested in using cover crops as green manures to improve his stony shallow soils. Despite James's efforts in improving soil organic matter levels and fertility using compost, cow muck, digestate, sewage sludge and straw, his soils are very prone to drought and are inherently low in organic matter.

What did he do?

James has previously used home-grown mustard to capture nitrogen left in the soil. This is especially useful for capturing residual nitrogen after a very dry season when crops suffered drought and were unable to utilise all of the nitrogen applied. Mustard has low costs but its inclusion in an oilseed rape rotation must be considered carefully, particularly regarding soil-borne diseases, such as clubroot.

In 2014, James decided to establish four demonstration plots of species mixtures among his mustard cover. These were direct-drilled straight into wheat stubble on 8 August. A range of species mixtures is available commercially; James used a mixture from DSV (Terralife mixtures) containing tillage radish, clover, field peas, phacelia, common vetch, bristle oat, sunflower, linseed, buckwheat, false flax and mustard.

What was the outcome?

James found the mixture established well and grew away rapidly. He feels a key benefit of a mixture is that plant species with a variety of rooting depths can access the full soil profile and species with deep tap roots, such as tillage radish, can potentially help to open up compacted soils.

Name	James and Tim Sills
Location	Cambridgeshire/Suffolk border
Size	1,000 ha
Soil type	Predominantly heavy Hanslope clay
Rotation	All combinable crops, incorporating straw



Cover crop roots open up soil structure.

He wanted to trial a cover crop with the aim of improving soil structure and fertility by increasing soil organic matter and nitrogen capture.

What did they do?

On the advice of Andrew Down (Catchment Sensitive Farming), James planted a mixture of oats, radish, linseed, buckwheat and stubble turnips as plots of a winter cover crop in August 2014 after barley.

A mixture was chosen over a single crop to give good surface coverage and a variety of rooting depths. The fodder radish provided a deep tap-root and the other components provided a variety of roots to spread through the soil profile.

What was the outcome?

Despite a slow start, there was enough coverage above and below

ground to encourage James and Tim to continue investigating further cover crops on a wider scale, in combination with direct drilling.

Further information

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Project Report 414: Influence of green manuring in wheat rotations under different cultivation systems (AHDB, 2007)

NIAB TAG National Agronomy Centre information:
www.niab.com/pages/id/272/TAG_Research_Online_News

Publications orders
0845 245 0009
cereals.publications@ahdb.org.uk

What was their objective?

Recently, James had been concerned about the sustainability of yearly intensive cultivations and the knock-on effect on soil health.



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