soil improvement solutions






Limagrain

soil improvement solutions

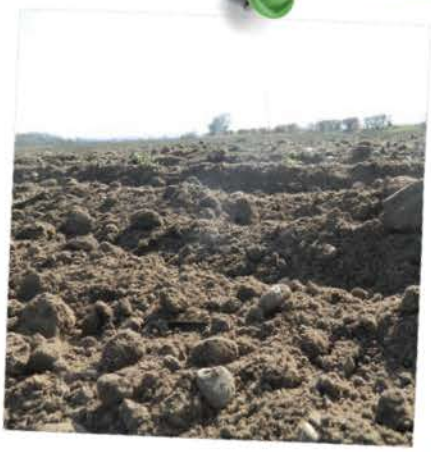
introduction

what is the most important asset on your farm?

Your buildings, machinery or maybe your livestock? Or is it your soil? Something that we too often take for granted and is the pillar of any successful farming enterprise.

The benefits of using other crops to help improve your soil is well recognised. With the greening rules covering crop diversification and nitrogen fixing crops, as well as Ecological Focus Areas (EFA) for both catch and cover crops. Our brochure aims to guide you through the benefits and techniques of growing a cover crop - which can improve your soil potential, improve fertiliser efficiency, and help the environment.

contents



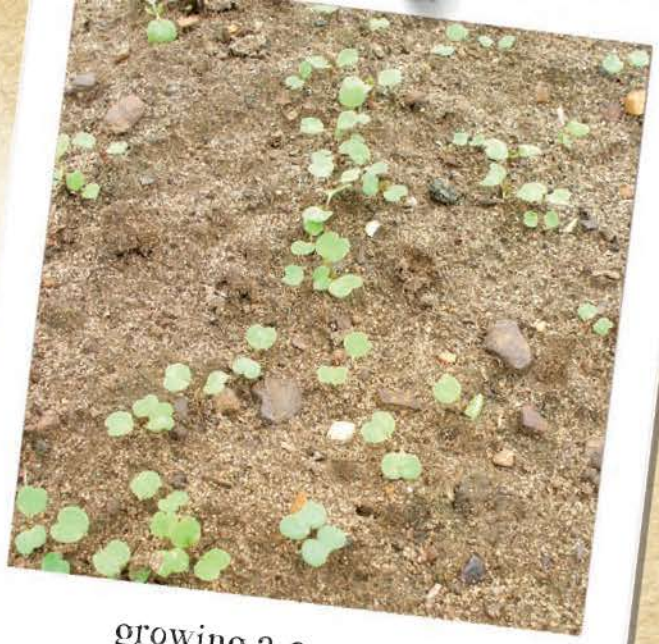
the benefits of cover crops

making the decision to grow a cover crop couldn't be simpler and there are so many benefits on offer

The advantages listed below will give you multiple financial reasons to include a cover crop in your rotation:

- Improved soil structure
- Retained moisture
- Reduced blackgrass
- Better drainage
- Increased soil biodiversity
- Increased worm activity
- Reduced compaction
- Weed suppression
- Carbon storage
- Improved fertiliser efficiency
- Nematode control
- Erosion reduction
- More organic matter
- Reduced disease pressure in the following crop
- Reduced leaching of nitrogen
- Reduced reliance on artificial inputs
- Improved soil health
- Nitrogen is released for use by the following crop

cover and catch crops



growing a cover crop

Cover and catch crops can play a vital role in reducing nitrate leaching and protecting water courses, as well as reducing erosion. The catch or cover crop must establish quickly and within the sowing period, achieve ground cover and have different rooting depths. The table below shows the sowing periods and list of crop species that can be sown as a mixture **(England only)**.

catch crop	cover crop
Mixture made up of at least **one cereal** and **one non cereal**	Mixture made up of at least **one cereal** and **one non cereal**
Must be established by 31st August	Must be established by 1st October
Must be retained until at least the 1st October (in the same year)	Must be retained until at least 15th January

- **Rye** • **Vetch** • **Phacelia** • **Mustard** • **Barley** • **Oats** • **Lucerne** • **Oilseed Radish**

Alternatively, grass can be counted as long as it was undersown in the previous crop and is sufficiently established.

There are no restrictions on the management of catch or cover crops outside these periods. The cover does not need to be destroyed after them, and can be grazed outside these periods **(England only)**.

mustard

phacelia

vetch

mixture selection chart

lift 'n' fix

sprinter

commando

	efa compliant	high organic matter production	soil conditioning	reducing soil compaction	blackgrass control	nematode control	nitrogen fixing	suitable for undersowing	suitable for grazing
Mixtures									
lift 'n' fix	✓	✓	✓		✓		✓		✓
soil improver	✓	✓	✓	✓					
sprinter	✓	✓	✓		✓		✓		
green reward		✓	✓	✓	✓		✓		
commando		✓	✓	✓	✓	✓			
red reviver	✓	✓	✓				✓	✓	✓
straights									
mustard	*	✓	✓			✓			
oilseed radish	*	✓	✓	✓		✓			
black oats	*	✓	✓		✓				
vetch	*	✓	✓				✓		

*EFA Compliant if part of a mixture

introduction to the species

maro red clover

An excellent N fixer which works well if sown with Italian ryegrass. Red clover can be productive for 2-3 years and exhibits good weed suppression qualities. Sow at 15kg per hectare in the spring or autumn.

maro red clover

crimson clover

An annual clover which is fast growing and quick to establish, with fantastic red flowers. Sow at 15kg per hectare.

crimson clover

bokito oilseed radish

Excellent biomass yield potential, ideally grown as winter cover that will produce deep roots to penetrate compacted soils. Bokito is club root tolerant and suitable for oilseed rape rotations. It is also frost resistant and has excellent weed suppressant. Drill or broadcast at 20kg per hectare.

bokito oilseed radish

humbolt winter rye

One of the best species to lift and hold N. Rapid establishment with good tillering and ground cover. Humbolt works well with vetch to prevent N leaching. It is possible to graze in the spring. Drill at 180kg per hectare.

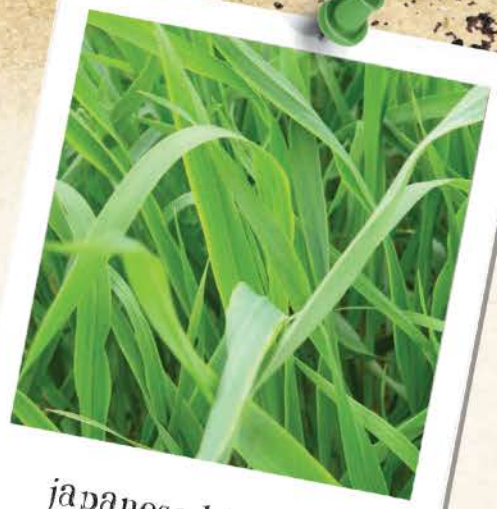
humbolt winter rye

attack mustard

Excellent biomass yields from a short growing period. Fast establishment, not as winter hardy as radish. Drill at 20kg per hectare.

attack mustard

daikon tillage radish



japanese black oat

carbon kale mustard hybrid

vetch

phacelia

daikon tillage radish

A deep-rooted, white radish which is able to penetrate compacted soils. Daikon is not club root tolerant and therefore not suitable for oilseed rape rotations. Drill at 20kg per hectare.

japanese black oat

A very fast growing cereal, with excellent ground covering properties. It can be sown with vetch, but it is not winter hardy (frost susceptible at -4°C). Black oats produce a substance known as Avenocins, which are antagonistic to blackgrass germination. Ideal for oilseed rape rotations. Drill at 30 – 35kg per hectare.

carbon kale mustard hybrid

A fast establishing crop with excellent biomass yields. Carbon has a high Glucosinolate content which makes it ideally suited for biofumigation. Carbon is more winter hardy than ordinary white mustard, and if left until the spring, will flower in April. Sow at 7kg per hectare.

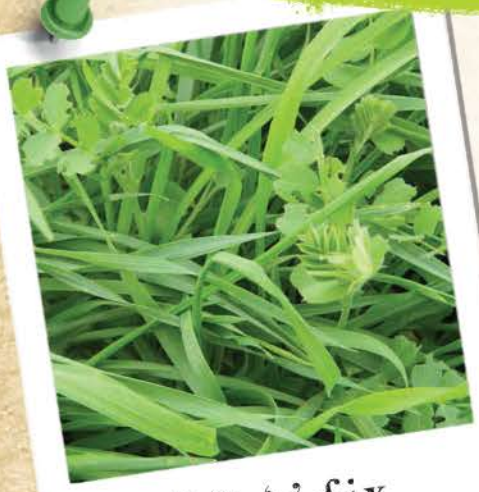
vetch

Slower growing, but once established, it can start fixing N in a relatively short period of time. Winter hardy, it works well grown as a companion with rye. Drill at 75kg per hectare.

phacelia

Fast establishment with pretty blue flowers that are very attractive to bees and other insects. Ideal for oilseed rotations and works well in mixtures. Sow at 10kg per hectare.

mixtures for soil improvement



lift 'n' fix

- Rapid establishment
- Excellent winter ground cover
- Excellent tillering and weed suppressant
- Winter Rye Humbolt is an effective nitrogen lifter
- Nitrogen is made available for following spring sown crops
- Deep roots help penetrate compacted soils
- EFA Compliant

soil improver

- Fast to establish
- Ideal to follow cereal harvest
- Combination of different species
- Root structure covers different levels of the soil profile
- Helps retain moisture for following crops
- Can also be used for gamecover
- EFA Compliant

sprinter

- Very fast to establish
- EFA Compliant
- Enables blackgrass to germinate prior to glyphosate application
- The Black Oats produce a substance called Avenocins, which inhibit blackgrass germination in the following crop
- Black Oat is a non-host to root lesion and stubby root nematodes
- Very good weed suppressant

lift 'n' fix contains:

80% Winter Rye
20% Vetch
100%

Seed packed in 20kg bags

Sow August to the end of September at 60-70kg per hectare

soil improver contains:

80% Winter Oats
8% Mustard
10% Oilseed Radish
2% Phacelia
100%

Seed packed in 20kg bags

Sow August to September at 40-50kg per hectare

sprinter contains:

70% Black Oat
30% Vetch
100%

Seed packed in 20kg bags

Sow August to September at 25-35kg per hectare

green reward

- Premium Multi species mixture
- Differing root depths and growth habits
- Rapid establishment
- Penetrates compacted soil
- High biomass yields with increased organic matter potential
- Good weed suppressant qualities
- Not suitable for EFA catch or cover crop options

green reward contains:

60%	**Winter Rye**
10%	**Black Oat**
7.5%	**Oilseed Radish**
7.5%	**Tillage Radish**
5%	**Mustard**
5%	**Vetch**
5%	**Phacelia**
100%	

Seed packed in 20kg bags

Sow August to September at 40-50kg per hectare

commando

- Specifically designed for biofumigation
- Contains plant species with high levels of isothiocyanates
- Fast establishment
- Easily chopped and incorporated
- Different root depths will also help soil compaction
- Always drill if possible as the seeds are small
- Not suitable for EFA

commando mixture contains:

50%	**Oilseed Radish**
25%	**Carbon Kale Mustard Hybrid**
25%	**Mustard**
100%	

Seed packed in 15kg bags

Sow August to September at 40-50kg per hectare

red reviver

- Designed to undersow cereal crops
- Fast establishment
- Crimson Clover will fix nitrogen
- Suitable for EFA cover crop option (undersown)
- Once established, it will help prevent water run-off and protect soils

red reviver contains:

70%	**Italian Ryegrass Blend**
30%	**Crimson Clover**
100%	

Seed packed in 20kg bags

Sow at 20kg per hectare

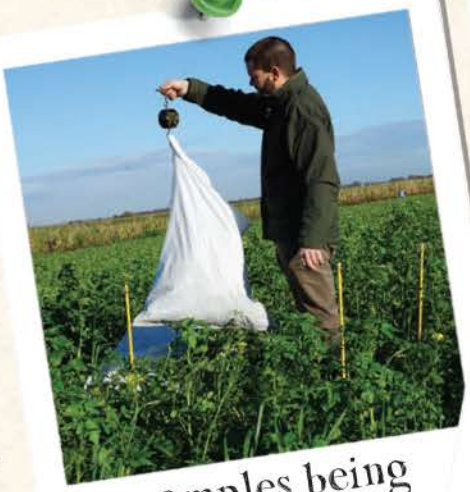
uk trial results

through the winter of 2015/16, Limagrain conducted a series of trials at several different sites, in order to demonstrate the benefits of our range of soil improvement mixtures.

The trials were designed to replicate typical on-farm practices, and measurements were taken in order to determine the relative quantity of biomass produced over the growing period, as well as the level of nutrients uplifted by each mixture. Optimum sowing date trials were also conducted.

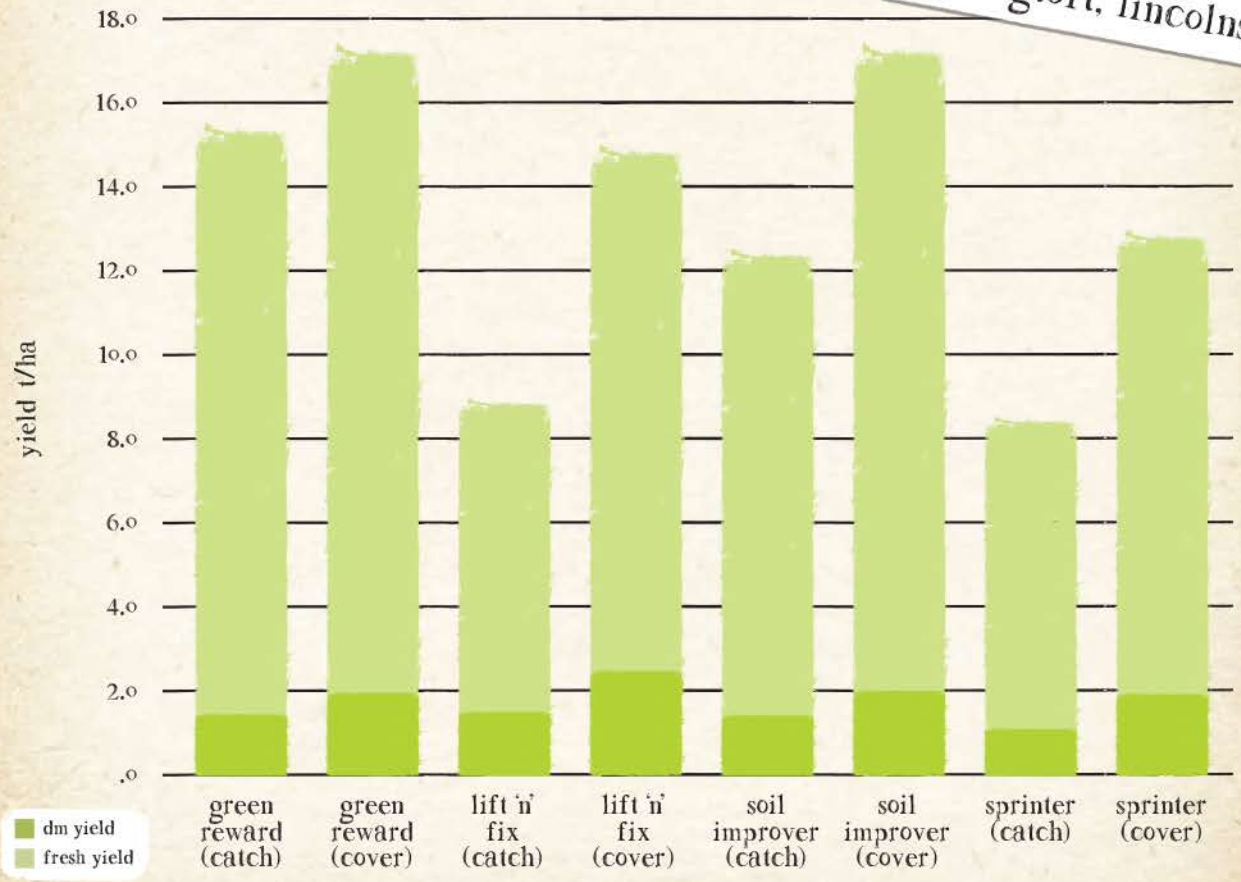
The results below allow growers to see how the potential short term benefits such as reducing nutrient leaching, can easily cover establishment costs. Additional benefits, such as those associated with improving soil organic matter, make the use of soil improvement products a valuable addition to any rotation.

vetch roots after 8 week of growth



samples being weighed

trial plots being drilled at langtoft, lincolnshire



The table above details the relative fresh and dry matter yields of the mixtures in trial. Measurements were taken of the above ground plant parts only after 8 weeks of growth, to simulate the EFA catch crop period, and after 12 weeks to simulate the EFA cover crop period.

all the mixtures trialled produced approximately 2-2.5t/DM per hectare over a 12 week growing period, with Green Reward and Soil Improver producing over 17t/Ha of green organic material.

	catch crop - 8 weeks				cover crop - 12 weeks			
	N Yield kg/ha	**P Yield kg/ha**	**K Yield kg/ha**	**Nutrient value**	**N Yield kg/ha**	**P Yield kg/ha**	**K Yield kg/ha**	**Nutrient value**
Green Reward	81.1	9.0	100.5	£95.08	70.7	11.9	101.6	£90.92
Lift 'N' Fix	64.2	7.1	92.2	£80.29	108.4	15.1	129.2	£126.85
Soil Improver	75.4	8.2	90.6	£87.14	91.2	11.2	117.6	£109.41
Sprinter	59.8	6.2	67.7	£67.29	78.4	9.8	108.9	£97.24

nutrient value estimated assuming ammonium nitrate @ £210/t, triple superphosphate @ £275/t, muriate of potash @ £240/t.

The table above shows the total amount of Nitrogen, Phosphate and Potassium present in the fresh green material after 8 and 12 weeks. A nutrient value has been calculated for each mixture, based on the equivalent fertilizer content being supplied as granular fertilisers.

The results show that all mixtures are able to uplift significant quantities of nutrients which could potentially be lost if the land had been left fallow. **Lift 'N' Fix** proved to be the most successful at retaining nutrients, with over **100kg of N** being captured by the mixture. Add the P and K, giving a nutrient value of **over £125 per hectare**.

Soil Nitrogen Supply (SNS)

The amount of residual nitrogen left in the soil after cropping can be anything from 50kg/Ha up to 200kg/Ha depending on the previous crop.

cost/benefit analysis

the short term benefits of cover crops can easily pay for the cost of establishment. The below table details those benefits that can be more easily valued, such as nutrient capture and the value of sheep grazing. In addition, the following crop may require fewer passes with cultivators, and with the correct management, could require a less expensive herbicide programme.

Benefits, such as those related to increased soil organic matter and general soil health, are more difficult to value financially, but may prove significant in the long term.

Example: Lift N Fix

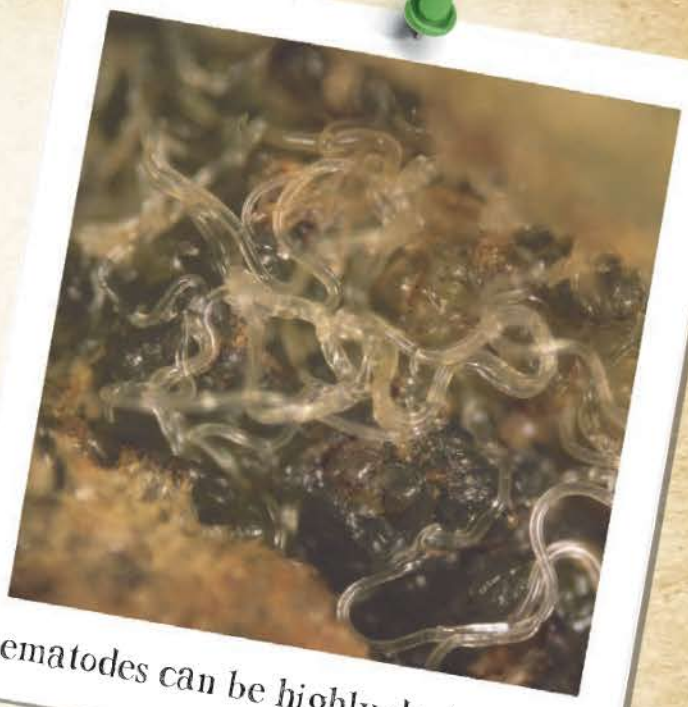
taking fresh samples

cost	benefit
Seed £64/Ha	N Value £66/Ha
Direct Drill £57/Ha	P Value £9/Ha
1 pass Sprayer + Glyphosate £17/Ha	K Value £52/Ha
	N Fixation >£10/Ha
	Sheep Grazing Value >£15/Ha
Total £138	**Total >£152/Ha**

nematode control

types of nematodes

Parasitic nematodes are present in almost all cultivated soils. The word nematode comes from the Greek word *nema* – which means 'thread', and the word *toid*, which means 'form'. Nematodes are microscopic worms 0.1mm in length; they vary in population density, depending on the soil type and plants being grown. There are many types of nematodes - some induce the host plant to produce nutrients which the nematode can survive on, some enlarge the plant root structures which they then live in, and some do both.



nematodes can be highly destructive

root knot nematodes

Root knot nematodes produce galls, especially on root crops, and can severely damage plant health. Crops at risk include peas, onions, carrots, parsnips; and spring wheat. Please note, that the knot nematodes *M. chitwoodi* and *M. fallax* have quarantine status.

cyst nematodes

Cyst nematodes grow and live within roots and eventually form bead-like cysts, visible on the root surface. They are widespread in the UK and throughout many parts of Europe. Crops at risk include potatoes, sugar beet, rape and beetroot.

lesion nematodes

These nematodes produce necrotic lesions throughout the cortex of infected roots. Crops at risk include carrots, parsnips, maize and some legumes.

stubby root nematodes

A large family of nematodes that cause plant roots to have a stunted or stubby appearance. The infected roots are less capable of supplying nutrients and water to the plant. Crops at risk are potatoes, sugar beet, onions, carrots and parsnips.

stem nematodes

Can cause distortion in the stems of winter beans and necrotic areas on plant leaves. Crops at risk are potatoes, onions, flower bulbs and winter beans.

symptoms of nematode damage

- Damaged plants in patches or along a row
- Stunted plants
- Wilting and plants without vigour
- Yellowing
- Stem distortion
- Crown and bulb swelling
- Root galls
- Root distortion and unusual growth

biofumigation

biofumigation mixture being incorporated

Biofumigation can be described as the incorporation of fresh green cover crops into the soil, which releases chemical substances known as isothiocyanates (ITC). These chemicals are able to suppress soil borne pests and diseases, fungal pathogens and weeds. Soil will also warm quicker to enhance biological activity. There are two main types of crop groups used for biofumigation:

- Prussic acid production with sudangrass
- Isothiocyanates production with white mustard, oilseed radish and *Brassica Carinata*

Plants that contain isothiocyanates have very high levels of glucosinolates (GLS), and when the plant is destroyed, it releases these, along with enzymes, into the soil. Under the influence of water, the GLS is turned into ITC. Often these species can be most beneficial when they are mixed together to create a wider ITC spectrum. Biofumigation can be used to control *Fusarium, Pythium, Rhizoctonia* and soil borne insects. For best effect, biofumigation works well on light textured, low organic matter soils.

benefits of biofumigation:

- Natural control of nematodes
- Traps and recycles nitrogen
- Improves soil structure by increasing organic matter
- Improved water retention
- Reduces soil erosion

commando mixture contains:

50% Oilseed Radish
25% Mustard
25% Carbon Kale Mustard Hybrid
100%

Sow at 20kg per hectare

sowing and growing

Seed should be sown into a well-worked, firm seedbed. The seeds within the biofumigation mixture are small and will only need to be drilled to a depth of 1-2cm. Seed can be broadcast into cereal stubble but rolling after is essential. To maximise the amount of green matter and therefore the glucosinolate content, use 70kg of N/Ha applied into the seedbed. Biofumigation crops can be sown in March/April, or in June, July and August, depending on the crop you intend to grow after the biofumigation process.

The mature crop should flower within 60-90 days and incorporation should be completed no later than 14 days after the first flowers appear. This will ensure maximum fresh yields are achieved and biofumigation will be most effective. The crop should be chopped and incorporated quickly to prevent the loss of ITC gasses. A flail mower is ideal, but the incorporation process of material into the soil needs to be within 15-20 minutes, and should be incorporated to a depth not exceeding 25cm. Always roll the soil after incorporation to seal the surface.

After biofumigation, subsequent crops can be sown after a two week period. Try to avoid disturbing the incorporated material.

growing a cover crop

growing a cover crop

before you sow

Cover crops are best sown in July, August or at the very latest, by early September. Ploughing and making a new seedbed will give the best results, but seed can be drilled or broadcast into cereal stubble after harvest. If timing is an issue, seed can also be broadcast into standing cereal crops.

A nitrogen application of 10-30kg per hectare will help the crop establish rapidly and ensure that there is a good amount of biomass for incorporation 8-12 weeks after the sowing date.

check before you sow...

- ☑ Harvest date and the time available to sow the cover crop.
- ☑ Weather - most cover crops are best sown in July and August and will need moisture to germinate.
- ☑ Soil type - determine the sowing rate.
- ☑ Sowing method - drilling or broadcasting?
- ☑ Ability to mow and incorporate the cover crop late in the autumn season.
- ☑ Cover crop selection - rotation, purpose and cost.

incorporation

The crop should be chopped and incorporated prior to frost. Crops are also best incorporated in the morning, but never incorporate a wet or dewy crop, as this could have a negative influence on soil structure.
Please be aware, EFA cover crops have fixed periods in which the crop must be retained.

introducing cover crops into your rotation

A few examples of crop rotations are shown below:

winter wheat	→	harvest	→	cover crops	→	sugar beet
legumes	→	harvest	→	cover crops	→	winter wheat
spring barley	→	harvest	→	cover crops	→	potatoes
winter barley	→	harvest	→	cover crops	→	maize
oilseed rape	→	harvest	→	cover crops	→	spring wheat

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