

COVER CROPS

TECHNICAL GUIDE



WHAT COVER CROPS CAN DO

Cover crops used correctly as part of your soil management strategy can deliver the following benefits:

- + **Capture and recycle nutrients** left over from the previous crop, rather than being leached away.
- + **Fix** nutrients from the atmosphere in association with soil bacteria.
- + **Improve soil structure** through root penetration at different depths – subject to the species used. Channels created by the roots open up the soil allowing free movement of air and water through the soil profile, even breaking up compacted layers at depth.
- + **Protect the soil from erosion** by water and wind, by holding soil in place with root and foliage growth.
- + **Help to suppress weed growth** either by direct competition and/or by allelopathic effect.
- + **Create a large biomass of fresh organic matter** which, when returned to the soil, will release nutrients over time to the following crops through the action of the soil biota. This helps to build organic matter levels and improve soil structure, particularly in low soil disturbance establishment systems.
- + **Increase the quantity of the biota** (bacteria, earthworms, fungi, insects) in the soil over time by having a growing crop and increased organic matter available for more of the year to feed them consistently. The increase in soil biota will then speed up the breakdown of organic matter, bring the carbon:nitrogen ratio into balance and make nutrients readily available to the cash crop.
- + **Growing the appropriate species** and varieties of cover and companion crops for your farm rotation can help reduce pest problems, particularly soil nematodes and cabbage stem flea beetle.
- + **Potential to save on cultivation costs** by direct drilling following a cover crop that has improved or maintained soil structure.
- + **Encourage farmland wildlife and beneficial insects** by creating cover and a food source over an extended period.
- + **Improve overall soil health**, which is the foundation for helping to promote good crop health, enhancing crop yields and farm sustainability.

- + **In the longer term, cover crops used as an integral part of the farming strategy** will improve farm incomes and sustainability by increasing soil fertility and productivity whilst reducing input costs.
- + **In our own trials work we have already seen some of these benefits** from the use of cover crops compared to fallowing land between cash crops.
- + **The key element in improving soil health and productivity in the long term**, is to increase its organic matter content and maintain living roots in the soil for as much of the year as possible. This can be done by selecting the correct cover crops for your farming operation.

WHY SOIL HEALTH IS IMPORTANT

Soil is fundamental for crop production, supporting delivery of 95% of the UK's food, and storing around 80 years' worth of GHG emissions in the form of carbon.# Soil health can be defined as the continued capacity of a soil to function as a vital living ecosystem that sustains plants, animals and humans. Healthy soils grow healthy crops that are better able to withstand disease and compete against grassweeds.



Harper Adams University

Agrii was one of founding partners of the Harper Adams Soil and Water Management Centre.

Soil is an ecosystem that can be managed:

- + A healthy soil provides a habitat for soil microbes to flourish and diversify – providing the nutrients that crops need to grow and prosper.
- + Soils store two thirds of the fresh water on the planet* and this function is determined by the level of organic matter in the soil. The loss of soil biodiversity reduces its water infiltration capacity, as well as its capacity to store water, lowering food production and worsening the impact of drought.
- + The carbon contained within soil organic matter represents one of the largest carbon stocks on Earth and plays a major role in mitigating climate change. In the UK our soils hold an estimated 9.8 billion tonnes of carbon.** When soil is eroded, the carbon stored in soils is lost in the form of greenhouse gases. Globally it is estimated that 26% of the carbon stored in the top one metre of soil has been lost since pre-historic times (FAO 2015).

The 'One Health' concept

Shows the relationship between ecosystems – soils, plants, animals and human health as being closely intertwined. (Adapted from: *The soil- human health nexus*. Edited by Rattan Lal, 2021.)



- + A well structured soil anchors crops and plants – allowing root systems to extend downward through the soil and in turn stabilise plants so that they can grow efficiently.
- + A well structured soil allows less erosion by wind or rain and reduces the likelihood of flooding due to improved porosity.
- + The minerals and microbes in soils help to filter, buffer, degrade and detoxify potential pollutants – including industrial by-products and atmospheric pollution.
- + Soil isn't an inert growing medium. Rather, a healthy soil is home for billions of organisms, including bacteria, fungi, insect larvae and earthworms that are the foundation of an intricate below-ground ecosystem.
- + Most of these organisms – big and small – are an essential part of enhancing the nutrients that stimulate plant growth.

*Environment Agency 2019

* IUCN - www.iucn.org/resources/issues-briefs/conserving-healthy-soils

**Soil Association figures

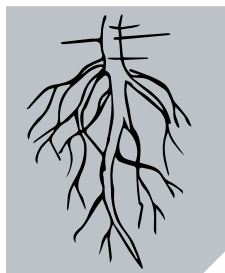


More information on the potential benefits of cover crops to soil health and organic matter levels can be found in **Green Horizons Insight Report 1: Improving Soil Resilience**.

Please go to www.agrii.co.uk/greenhorizons to view, or ask your agronomist for a copy.

COVER CROP VARIETIES IN DETAIL

BRACO – WHITE MUSTARD



STALA – PHACELIA



USE



DRILLING

Late summer, mid September latest.
Full seed rate drilled at 12kg/ha. Typical TGW 8g.

HOW TO DESTROY

If late summer sown, a strong frost should destroy the crop, although root and stems will remain. In the south it may need spraying off or rolling before it sets seed.

OTHER INFORMATION

- + C:N ratio 30.
- + Reliable, very fast establishment.
- + Good at extracting moisture and nutrients from the upper soil profile.
- + Beet cyst nematode reducing variety.
- + Lower seed cost.



Late summer drilled crops need to go in before the end of August. Full seed rate drilled at 10kg/ha. Typical TGW 2g.

If late summer sown, the frost will destroy the crop leaving very little residue. In a mild autumn it may need spraying to stop seed set.

- + C:N ratio 20.
- + Reliable, fast establishment.
- + Very fibrous root system down to 8cm creating a very good soil structure in drilling zone.
- + Good surface nutrient capture and weed suppression when growing.

KEY:



Soil Structure



Nematode Reduction



Weed Control



Nutrient Capture



Nutrient Production



Frost Susceptible

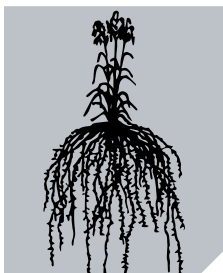


Grazing/Silage

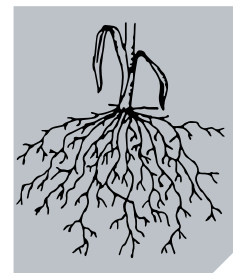


Environmental Benefits

CADENCE/LUXURIAL – BLACK OATS



FORAGE RYE



USE



DRILLING

Best sown late summer, before end of August.
Full seed rate drilled at 30kg/ha. Typical TGW 20g.

Best sown from mid August until early October.
Full seed rate drilled at 160kg/ha. Typical TGW 38g.

HOW TO DESTROY

Black oats are frost sensitive and can die back naturally during prolonged cold periods.

Spray off in the spring or graze or silage.

OTHER INFORMATION

- + C:N ratio 25.
- + Good establishment.
- + Large fibrous root system creates good soil structure.
- + Resistant to diseases, take all and good tolerance to BYDV.
- + Reduction of root knot and root lesion nematodes.

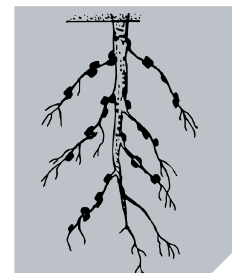
- + C:N ratio 35.
- + Reliable, quick ground cover.
- + Extensive root system, good scavenger of nutrients, will continue to grow even in cold conditions.

COVER CROP VARIETIES IN DETAIL

BINGO/TITANE – PURPLE SPRING VETCH



TABOR – BERSEEM CLOVER



USE



DRILLING

Drill before the end of August.
Full seed rate 30kg/ha. Typical TGW 39g.

Drill before the end of August at 10-15kg/ha.
Typical TGW 3g.

HOW TO DESTROY

Late summer sown, a strong frost should destroy the crop.

Late summer sown, a strong frost should destroy the crop.

OTHER INFORMATION

- + C:N ratio 12.
- + Purple vetch are the fastest growing of the vetch species which enables them to catch and fix the maximum amount of nitrogen in the limited time available.

- + C:N ratio 14.
- + Tabor is a single cut variety that will not regrow if topped.
- + Very quick growing with a long tap root.
- + Useful as a companion crop for OSR.

KEY:



Soil Structure



Nematode Reduction



Weed Control



Nutrient Capture



Nutrient Production



Frost Susceptible



Grazing/Silage



Environmental Benefits

CEGALO – CRIMSON CLOVER



USE

Full drill rate 15kg/ha before the end of August.
Typical TGW 5g.

DRILLING

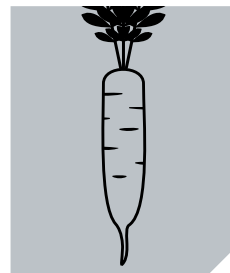
HOW TO DESTROY

Spray off, if not killed by frost.

OTHER INFORMATION

- + C:N ratio 16.
- + Faster establishment and good biomass.
- + Strong tap root and lateral roots.

ASIAN/DAIKON RADISH



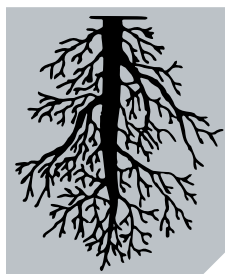
Best sown before the end of August.
Full seed rate 12kg/ha. Typical TGW 20g.

Will be destroyed by a hard frost.

- + C:N ratio 35.
- + Very large, strong tap root, good for soil structure improvement.
- + Large root scavenges and holds more nutrients.

COVER CROP VARIETIES IN DETAIL

OILSEED RADISH



NEMATODE REDUCING VARIETIES

Group 1: Reduction of Beet Cyst Nematodes by over 90%

KWS REBELLION

- + Very high levels of BCN reduction.
- + Good early vigour.
- + Medium biomass.
- + Extensive strong root system.
- + Very late maturity.
- + Frost hardy to -5°C.

Group 2: Reduction of Beet Cyst Nematode of 70-90%

COBRA

- + Multi resistance to beet cyst and root knot nematode. (*Meloidogyne chitwoodi*).
- + Very vigorous early growth.
- + Large biomass.
- + Extensive strong root system.
- + Late maturity.
- + Frost hardy to -5°C.

EVERGREEN

- + High biomass and dry matter
- + High resistance to BCN.
- + Very fast early growth, late maturity.
- + Strong extensive root system.
- + Frost hardy to -5°C.

USE



DRILLING

Sow from late July to mid September. Full seed rate 12-20kg/ha depending on use. Typical TGW 11g.

HOW TO DESTROY

Spray off in early spring, unless destroyed by several hard frosts (-5°C).

OTHER INFORMATION

- + C:N ratio 30.
- + Very strong tap root will break through compacted soil.
- + Good scavenging and holding of nutrients within high biomass crop.
- + Effective nematode reduction, variety dependant.
- + Non-host to clubroot.
- + Nematode reducing varieties.

WHICH COVER CROP MIXTURE TO GROW?

Which soil issue is most important to resolve?

Poor soil structure, low organic matter/carbon levels, high levels of blackgrass, high populations of harmful nematodes, risk of nutrient leaching and soil erosion.

What positive effects are you looking to achieve?

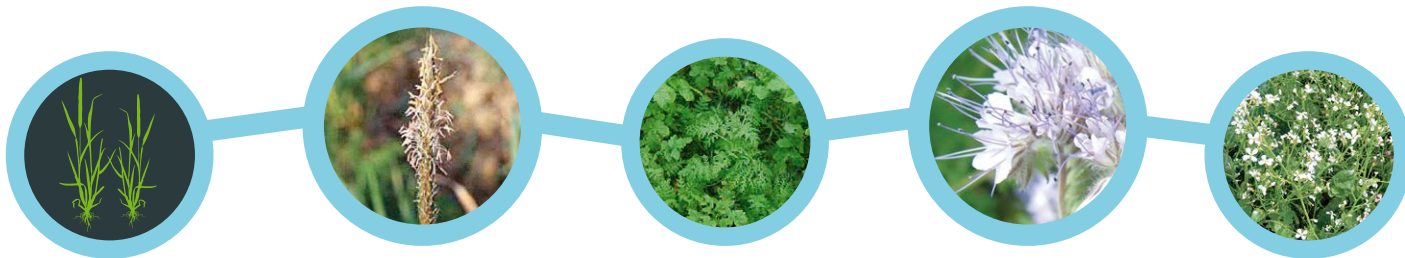
Reduce cultivation costs, boost soil fertility, help manage blackgrass levels, reduce pest pressure, long term soil health improvements and farming sustainability.

Key considerations:

- + **What is your crop rotation?** Avoid cover crops that may increase disease and pest pressure in close rotations.
- + **When will you be able to drill the cover crop?** Generally best growth/results come from early August sowings, choice of species should change if September sown.
- + **How long do you want the cover to last?** Do you require a short term cover prior to late autumn sowing, a longer term frost-susceptible mix which may save on destruction costs, or a full cover until the spring to maintain soil protection?
- + **Will the catch/cover crop be used for livestock grazing** to produce additional income?
- + **What type of drill** will you use to establish the following crop?
- + **What is the likely Carbon:Nitrogen ratio of the cover crop?** The C:N ratio of a species/mixture gives an indication of the speed of breakdown and release of nutrients. This is important to understand as you may need to adjust your nutritional inputs to the following crop depending on when this occurs.

High C:N ratio covers crops will take nitrogen from the soil reserves as the soil biota starts the process of breaking down the carbon in the cover crop, which can restrict the amount of nitrogen freely available in the early stages of the following crop.

Low C:N ratio cover crops will conversely break down much more quickly, making nutrients available earlier, and returning a greater percentage of the total within the life-cycle of the following crop.



AGRII SPECIALIST COVER CROP MIXTURES

STRUCTURATOR 1

Use in OSR-free or extended rotations.

- + Strong, diverse rooting system
- + Creates a friable soil structure
- + Non-host for cereal diseases
- + Medium/high biomass

	%	Kgs/ha	Seeds/m ²
Black oats	65	13	65
Oil radish	20	4	34
Phacelia	10	2	100
Asian radish	5	1	5
Seed rate 20kg/ha			204
Cover crop C:N ratio 35			

STRUCTURATOR 2

Use in rotations including OSR.

- + Strong, diverse rooting system
- + Creates a friable soil structure
- + Clubroot resistant oil radish
- + Medium biomass, cold tolerant

	%	Kgs/ha	Seeds/m ²
Winter rye	70	17.5	48
Oil radish	15	3.75	38
Phacelia	10	2.5	125
Linseed	5	1.25	18
Seed rate 25kg/ha			229
Cover crop C:N ratio 38			

All of the cover crop mixtures on these pages should provide the following benefits to the grower, in addition to their specific uses:

- + Mop up, hold and fix nutrients
- + Reduce leaching
- + Increase levels of organic matter and soil biota
- + Improve soil structure
- + Suppress weeds
- + Provide habitat for farmland wildlife and improve farm sustainability and income

N CAPTURE & FIX

Use in all rotations.

- + Brassica-free mix
- + Diverse root types
- + Captures and fixes nutrients
- + Medium biomass

	%	Kgs/ha	Seeds/m ²
Black oats	50	9	45
Spring vetch	20	3.6	6
Crimson clover	12	2.16	43
Berseem clover	10	1.8	60
Phacelia	8	1.44	72
Seed rate 18kg/ha			226
Cover crop C:N ratio 24			

ECO SOIL PROTECTOR

Economic cover for all rotations.

- + Fast establishment, nutrient capture and fix
- + Full season cover
- + Medium biomass

	%	Kgs/ha	Seeds/m ²
Winter rye	80	28	76
Vetch	20	7	12
Seed rate 35kg/ha			88
Cover crop C:N ratio 35			

The species and varieties used within the mixtures have been specially selected to meet UK conditions, with particular emphasis on speed of establishment, maturity date and field performance.

Seed size – thousand grain weight (TGW) is also an important consideration in species/variety selection, with the aim to reduce variability which aids drilling and helps target the optimum plant numbers per square metre.

AGRII SPECIALIST COVER CROP MIXTURES

Solar Mixtures Designed to intercept the maximum amount of sunlight in order to increase carbon sequestration potential.

REGENERATIVE MIX

		%	Kgs/ha	Seeds/m ²
+ Multi-species mix				
+ Diverse leaf canopy to intercept maximum solar energy	Spring vetch	30	7.5	13
	Black oats	24	6	27
	Berseem clover	10	2.5	70
+ Brassica-free	Linseed	10	2.5	41
+ Nutrient capture and fix	Sunflower	9	2.25	4
	Crimson clover	8	2	40
+ Varied root types to stimulate soil biology and improve structure	Buckwheat	5	1.25	7
	Phacelia	4	1	50
	Seed rate 25kg/ha			252
Cover crop C:N ratio 22				

SPRING CEREAL SOIL FERTILITY BUILDER

Non-cereal cover mix pre spring cereals on medium/light soils.

		%	Kgs/ha	Seeds/m ²
+ Cereal-free mix for light/medium soil types				
+ Nutrient capture and fix	Spring vetch	42	8.4	14
	Oil radish	20	4	40
	Crimson clover	15	3	60
+ Lower C:N ratio	Buckwheat	15	3	17
	Phacelia	8	1.6	80
+ Medium/high biomass	Seed rate 20kg/ha			211
	Cover crop C:N ratio 20			

Seed should be drilled before the end of August to ensure good establishment and maximise biomass.

Adjust seed rates to account for soil conditions and drilling date.

CONSERVATION MIX

		%	Kgs/ha	Seeds/m ²
+ Multi-species mix				
+ Diverse leaf canopy to intercept maximum solar energy	Winter rye	30	7.5	20
	Spring vetch	30	7.5	13
	Oil radish	15	3.75	38
+ Nutrient capture and fix	Crimson clover	8	2	40
	Buckwheat	5	1.25	7
+ Varied root types to stimulate soil biology and improve structure	Linseed	4	1	16
	Phacelia	4	1	50
	Berseem clover	4	1	28
+ Higher biomass and carbon content	Seed rate 25kg/ha			212
	Cover crop C:N ratio 30			

FORAGE COVER CROP MIX

		%	Kgs/ha	Seeds/m ²
+ Dual purpose mix for arable and livestock farms				
+ Soil conditioning and forage production	Winter rye	55	13.75	37
	Spring vetch	20	5	9
	Stubble turnips	10	2.5	65
+ High biomass	Smart radish	10	2.5	20
	Phacelia	5	1.25	63
+ Nutrient capture and fix	Seed rate 25kg/ha			194
	Cover crop C:N ratio 38			

Bespoke custom mixtures are available from our Agrii Lincoln seed production facility, please enquire.

ESTABLISHING THE COVER CROP

Key considerations:

TIME OF DRILLING

Many of the species require reasonable soil temperatures and day length. Drill immediately after harvest, ideally most cover/ catch crops should be drilled by the end of August to give sufficient biomass and rooting.



SOIL MOISTURE LEVELS

Good seed/soil/moisture contact is required to get quick emergence of the mixtures. Soil moisture needs to be conserved and ideally minimal soil disturbance should be considered during the sowing period.



SOIL NUTRIENTS

To achieve a well grown cover crop, early nutrition in the form of nitrogen is required, depending on previous cropping soil N reserves and if there is a high level of straw residue, approx. 20-30 kg of N/ha will be required to aid establishment.



PREVIOUS CROP

An important consideration particularly if there are high levels of straw residues; cover crops could be held back and overall level of establishment will be disappointing.

If following winter barley, then removal of the barley straw would be useful, if not the straw and chaff residues need to be evenly distributed prior to drilling.

Very good establishment of cover crops has been achieved behind pea and bean crops, also after a fallow situation.



PESTS

Slug pressure needs to be assessed following the previous crop. If the pressure is high then slugs need controlling before establishing the cover crop.

Pea and bean weevil can cause serious problems for the vetches and clover species, if the pressure is high and insect activity is causing damage the appropriate insecticide should be used.

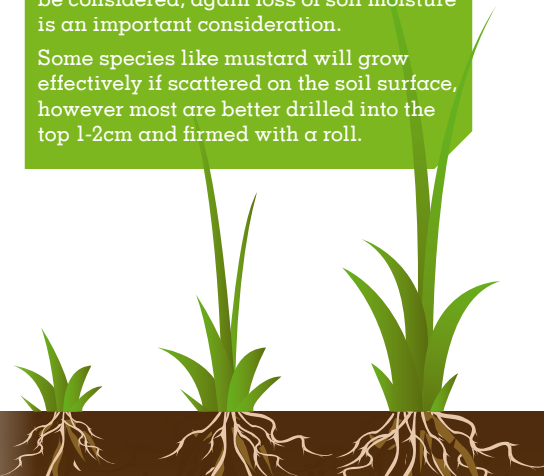


ESTABLISHMENT TECHNIQUE

Cover crops need good soil structure and a workable soil to achieve maximum growth. Soil compaction needs to be addressed both for the cover and also for the following crop, therefore subsoiling should be completed if required.

A subsoiler with a tine that stops large amounts of surface disturbance should be considered; again loss of soil moisture is an important consideration.

Some species like mustard will grow effectively if scattered on the soil surface, however most are better drilled into the top 1-2cm and firmed with a roll.



DRILLING THE FOLLOWING CROP

To maximise the benefit of the cover crop within the farm rotation, the following areas need to be considered before establishing the following crop.



Key considerations:

TARGET DRILLING DATE



Have a target drilling date on which to base your planning and operations.

DESTRUCTION OF COVER CROP



If the cover crop has not been destroyed by frost or grazed, you will need to consider the soil type and density of the cover to determine when to spray off the cover in order to allow time for the soil surface to dry to aid drilling. This could be up to 8 weeks on heavy soils with a dense cover crop.

PESTS



Assess the slug pest pressure before crop establishment, treat if necessary.

CROP NUTRITION

The nutrient requirement of the following crop may differ to normal practice in respect of application timing and amount used depending on the cover crop species within the mix.

The C:N ratio of a particular mix will determine the time it will take and how much nitrogen will be required from the soil N reserve to decompose the cover crop residue and release nutrients to the following crop. This is because the soil micro-organisms require a C:N ratio of 24:1 to work efficiently and maintain a healthy balanced soil.

Cover crop residues with a higher C:N ratio will require more N from the soil and therefore less is initially available to the following crop, inhibiting growth.

Low C:N ratio residues including N fixing species will release excess N quickly boosting early crop growth and reducing the overall N requirement.

The target is to maintain a crop residue covering the soil surface with a C:N ratio of between 25 and 30 to help maintain a healthy living soil that will release nutrients at a uniform rate.



DRILLING

Whichever type of drill you use to establish the next crop, the aim is to move only the minimum amount of soil required to create good seed to soil contact.

Excessive soil movement will stimulate unwanted weed germination and undo some of the benefits gained from the cover crop.



OILSEED RAPE COMPANION CROPS

- + **Agrii has been trialling a range of companion crops for use with oilseed rape** to assess their ability to reduce the damage done by Cabbage Stem Flea Beetle (CSFB) and their larvae as one part of the strategy to grow OSR successfully.
- + Agrii trials have shown the use of buckwheat, when established well, reduced the damage to oilseed rape plants by the adult CSFB during the establishment phase and continued to do so through the autumn until the first cold nights when the buckwheat died back. This extended period of protection reduced the number of CSFB eggs laid on the OSR and importantly resulted in lower larvae numbers per plant in the spring.
- + It has also been noted in trials that OSR plots that had a buckwheat companion crop appeared to be more vigorous and with an even growth habit in the spring. This may be a consequence of reduced larvae damage or a benefit of its phosphorus scavenging and release properties boosting the OSR.
- + Having identified buckwheat as the best companion crop option for OSR CSFB defence, we tested the species of buckwheat available, *Fagopyrum Esculentum* and *Fagopyrum Tataricum*, to identify the one with the best attributes and performance. **Lifago (*Fagopyrum Tataricum*)** proved to be the best option (see information opposite), although both types are effective.
- + In areas with low CSFB pressure and where soil structure and nutrient building are more important than **Tabor berseem clover** and **Bingo purple vetch** will help enhance establishment and crop growth.
- + Companion crops should be used as part of the oilseed rape establishment strategy, but not relied upon solely as the only defence against CSFB. **Please see the Agrii 8 Point Plan for cultural control of cabbage stem flea beetle for more information: [CLICK HERE](#)**

Lifago buckwheat

Lifago (*F. Tataricum*) gave the best results in field trials, although both types were effective. Lifago has a unique combination of traits:

- + Seed TGW, size and shape – allowing easier mixing, better seed flow and lower seed rates.
- + Plant development and structure – fast emergence, large leaf area and later flowering habit giving the OSR seedling more protection for longer.
- + Cold susceptibility and phosphorus release – readily dies back and breaks down in low temperatures releasing nutrients to the established OSR crop.

Comparison of *Esculentum* and *Tataricum* buckwheat



Comparison of buckwheat seed



Typical TGW 28g

Typical TGW 16g

The lower TGW and shape of Lifago allows easier mixing with the OSR seed. Recommended sowing rate 10kg/ha with oilseed rape seed.

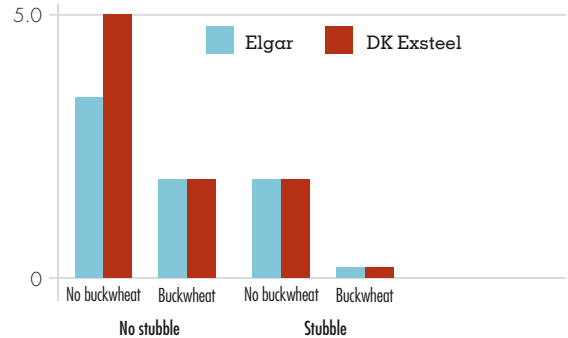
OILSEED RAPE COMPANION CROPS

Results of the oilseed rape trial at Langley, Essex.

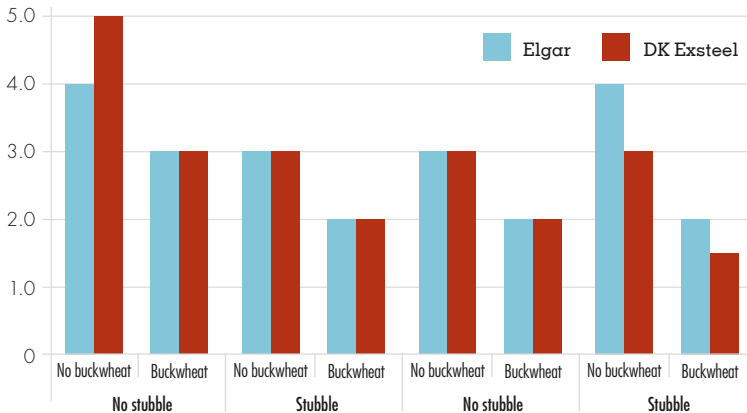
Assessment of the effect of using cereal stubble and Lifago buckwheat as a companion crop, alone and in combination, in the reduction of cabbage stem flea beetle damage in oilseed rape.

The trial shows a reduction in CSFB damage with both treatments and the cumulative positive effect when used in combination.

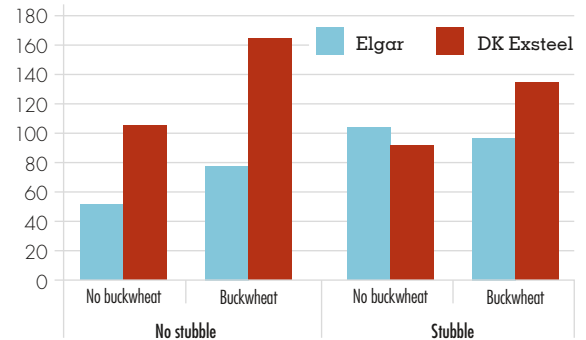
Adult flea beetle damage (scale of 1-9) on 15th October & 8th November 2019



Adult flea beetle damage (scale of 1-9) on 15th October & 8th November 2019



Fresh weight (g) - 3rd April





Connect with Agrii

Via our Agronomy and advisory teams

We have over 300 agronomists and technical specialists throughout the UK

At an Agrii iFarm Event

We have 28 iFarm and Technology Centre demonstration farms throughout the UK



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Thank you for reading this. We hope you found it useful.

Please note that the content within this document does not represent advice, which should always be tailored to local situations. Please speak to your adviser for more detailed information on any of the topics covered.

