December 2023

Annual Project Report
(harvest 2023)

On-farm trials at
Strategic Cereal Farm South

CONTENTS

1. Introduction

Host farmer: David Miller

Location: Wheatsheaf Farming Company, Hampshire

Duration: 2021–2027

AHDB Strategic Cereal Farms put cutting-edge research and innovation into practice on commercial farms around the UK. Each farm hosts field-scale and farm-scale demonstrations, with experiences shared via on-farm and online events to the wider farming community.

[Strategic Cereal Farms]

David has embraced regenerative agriculture practices for over a decade. The farm has adopted cover crops and been fully no-till since 2015. He will continue this journey and aims to reduce input use on the farm. This farm's goal is to be profitable, while maximising carbon sequestration and biodiversity.

2. Soil and crop health: impacts of different management systems

Trial leaders: Callum Scotson and Joe Martlew, NIAB

Start date: September 2021

End date: Ongoing

2.1. Headlines

- This project investigates the effect of cultivation and management strategies on soil health and crop health and productivity/profitability
- It monitors seven fields that have been managed with the principles of regenerative agriculture for over ten years
- It also compares three of these fields (called focus fields) with another (Typhrees) that is transitioning to a regenerative system from a conventional system
- In 2023, the three focus fields did not have the same crop as Typhrees, which is in continuous spring barley with a diverse overwinter cover crop
- However, the 2023 monitoring results provide useful information to integrate with full data set (from the previous and future seasons)

2.2. What was the challenge/demand for the work?

In 2021, the farm took on a new area of land that had been conventionally managed in continuous spring barley and brought it into more regenerative management by reducing tillage intensity and including diverse cover crops.

Soil and crop health across the rotation will be monitored, together with agronomic and financial performance to help assess the approaches. The work will also develop methods to compare nutrient density of the end product from different management approaches. This aim will be addressed by work in the harvest 2024 season.

2.3. How did the project address this?

Trial design

This project monitors seven fields that have been under a management system that has incorporated the principles of regenerative agriculture for about ten years:

1. 70 Acres field (2023 = spelt wheat following spring beans)
2. Old Park field (2023 = winter oilseed rape with buckwheat and clover companion following spring barley)
3. Rye Furlong field (2023 = winter oilseed rape with buckwheat and clover companion following spring barley)
4. Ashen Grove (2023 = winter wheat, variety Extase, following wheat)
5. Waltham Marks (2023 = winter beans following wheat)
6. Piggery (2023 = diverse cover crop/spring barley following wheat)
7. Big Grange (2023 = diverse cover crop/spring barley following wheat)

Three focus fields (70 Acres, Old Park, Rye Furlong) were selected in 2021 to provide a comparison with an additional focus field:

8. Typhrees field (continuous spring barley with diverse cover crops)

This field was conventionally managed but is transitioning to a more regenerative management system.

Assessments

The soil health status and crop performance of these fields are assessed to give an overall assessment for the farm rotation.

Crop establishment and health assessments:

- No soil health assessments were made in 2022. Soil health assessments (using the AHDB soil health scorecard) were done in November 2021 and will be repeated in November 2023 and 2025
- Soil samples were collected from sites in the four focus fields in November 2022 and March 2023 and immediately submitted for mineral nitrogen analysis (Lancrop, YARA, Pocklington, UK)
- Initial establishment was assessed using plant counts and percentage green cover scores in 1m^2 sample areas at 15 sites in each field
- To monitor general crop health, pest/disease status was monitored throughout the growing season

Yield and harvest sample analysis:

- Crop yield was assessed from the cleaned combine yield data
- Grain samples were collected from four sampling areas within each of the four focus fields and submitted for nitrogen and protein analysis (NIAB Labtest, Cambridge, UK)

2.4. Results (to date)

Soil mineral nitrogen:

No significant differences in soil mineral nitrogen occurred between the focus fields. Total soil mineral N was 30–50 kg N /ha. Typhrees has soil organic matter of 3.7%; the other focus fields have soil organic matter of over 4%.

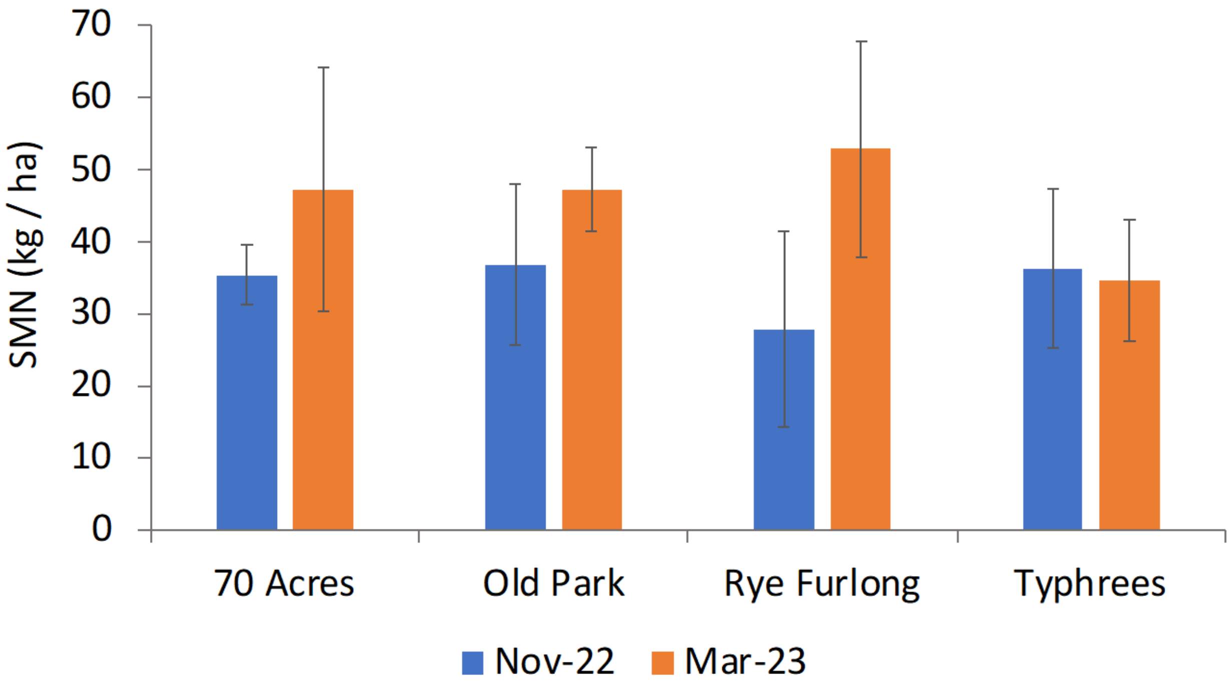

Figure 1. Soil mineral nitrogen (SMN) content in topsoil from each of the four focus fields. There were no significant differences between the fields (error bars show standard deviation)

Crop establishment assessments:

The spelt wheat crop in 70 Acres generally established well, though there were some areas of patchy establishment. The winter oilseed rape crops in Old Park and Rye Furlong established well (despite a drop in plant numbers at 6 and 8 weeks post-drilling) and provided a significant winter canopy. Finally, the cover crop in Typhrees established successfully, unlike in the previous season, though there were some areas of patchy establishment, and in most areas maintained reasonable ground cover. Spring barley established well in Typhrees in spring 2023.

Crop health and disease pressure:

Disease levels were low throughout the season and no significant pest damage was noted in any crop.

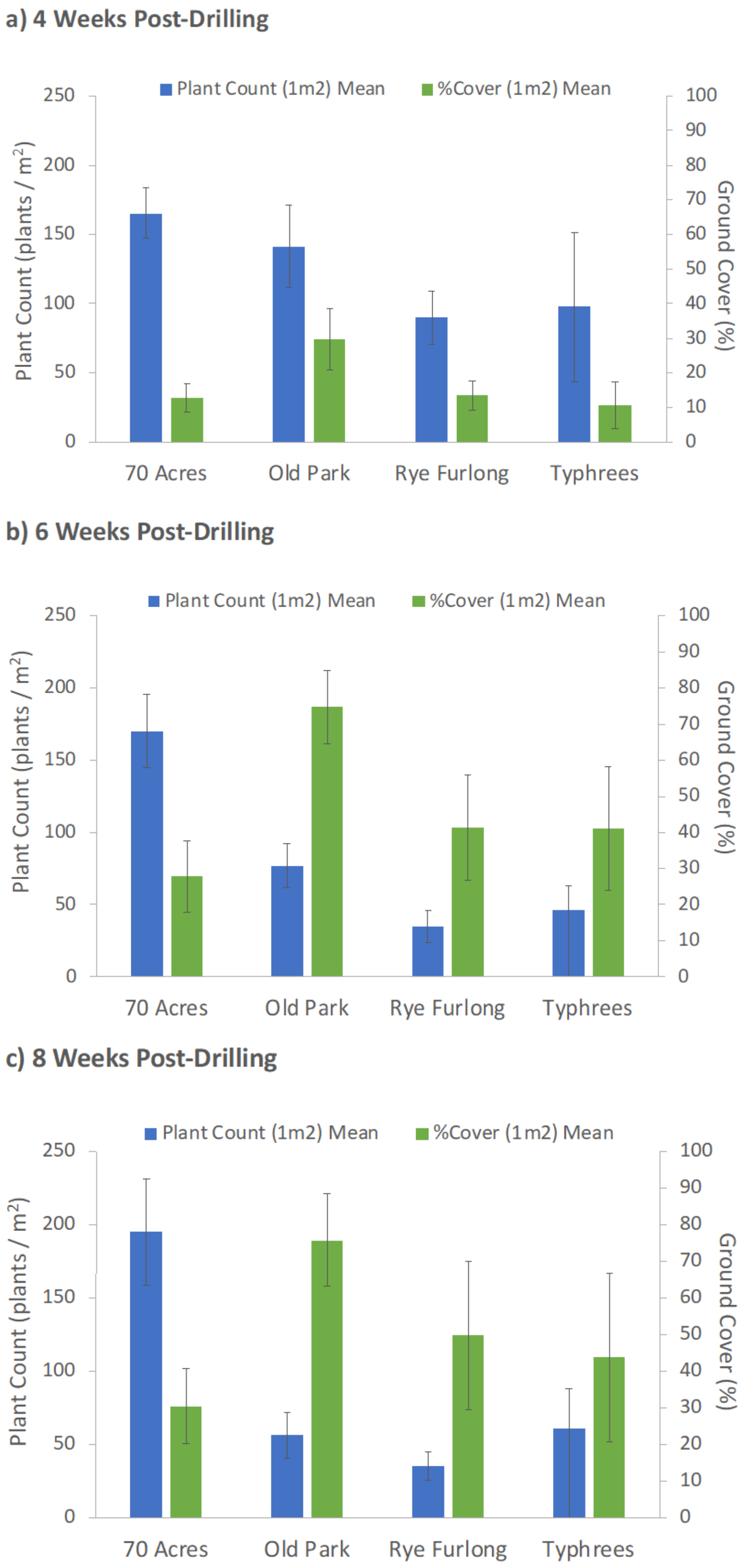

Figure 2. Mean plant count and percentage green cover across the four different fields at a) 4, b) 6 and c) 8 weeks post-drilling

Yield and grain analysis:

Different crops were grown in the comparator focus fields than in Typhrees in 2023. This makes any yield/quality comparison irrelevant in this season (Table 1). No grain samples were collected across the wider farm fields and, hence, the spring barley crops in Piggery and Big Grange could not be compared. In 2022, spring barley in Typhrees had a higher yield (7.1 t /ha) with higher specific weight (68.6 kg/ hL) and slightly lower protein (9.31 g/ 100g).

Table 1. The average yield (t/ha) recorded in each of the monitored fields. Quality data for the focus fields only. Analysis provided by NIAB Labtest (Cambridge, UK)

Field	Crop	Average yield in sample zone (t/ha)	Moisture content	Specific weight (kg/hL)	Protein content (g/100g)	Oil content (dry atter basis)
70 Acres	Spelt	6.4	13.8	40.4	*	n/a
Old Park	WOSR	4.2	7.1	66.8	n/a	51.5
Rye Furlong	WOSR	4.5	7.1	67.3	n/a	51.1
Typhrees	Spring barley	5.9	14.8	61.7	9.53	n/a
Ashen Grove	Winer wheat	9.3	No samples collected			
Waltham Marks	Winter beans	2.7	No samples collected			
Piggery	Spring barley	8.4	No samples collected			
Big Grange	Spring barley	4.7	No samples collected			

* Note that detailed quality analysis is not possible commercially for spelt as it cannot be dehulled.

2.5. Action points for farmers and agronomists

When establishing a long-term monitoring programme to study farm performance, the value of the data collected will increase over seasons. In some years, the stand-alone value of data collected may seem low, but in a well-designed study, it should be possible to draw some comparisons in each year. For example, grain samples could have been collected in the other farm spring barley crops in 2023.

3. Soil health at crop establishment

Trial leader: Callum Scotson and Joe Martlew, NIAB

Start date: September 2021

End date: September 2023

3.1. Headlines

- This project examined the effects of two products (targeting biological enhancement) with different modes of action (vermicompost humates and molasses with microbial nutrition) applied with seed on early crop development, root growth and soil health
- No significant differences were detected in crop establishment or root development metrics between untreated areas and any of the treatments (in the soil/season/crop combinations studied)
- The farm is now confident that the longer-term, soil-improving measures (cover cropping and no tillage in combination) have improved the soil health baseline effectively so that any benefits of tactical applications of amendments are not detectable
- From autumn 2023, the trial will change its focus to assess whether a companion crop with wheat has benefits for soil biology and early crop growth
- Given the inherent variability within soils and root growth habit, anyone thinking of using (or ceasing use of) similar products should consider carrying out strip trials to support decision-making

3.2. What was the challenge/demand for the work?

The farm wants to know more about how the soil functions together with benchmarks for healthy soil, especially during the critical phase of crop establishment. Continuing the trial from harvest 2022, the farm applied a second application of soil amendments (targeting biological enhancement) to the same tramlines with the aim of enhancing the soil–plant interaction at drilling.

3.3. How did the project address this?

Trial design

There are four treatments included within this project:

1. Untreated seed (control)
2. Vermicompost humate extract (VCH - Ecoworm)
3. Molasses + (L-CBF Boost)
4. VCH and Molasses + (combined)

This trial was located within Fish Ponds field. For harvest 2023, the focus was on a spring wheat (2nd wheat) after an overwinter cover crop. This was a replicated tramline trial where the positioning of the treatments was randomised. At drilling, the tramlines were relocated and treatments were repeated.

Figure 3. Layout of the tramline treatments in Fish Ponds field

The influence of these products on the establishment, root development and productivity of the winter wheat crop was assessed over the course of the year. In addition, the soil health and soil biology status were also examined across these treatments.

Assessments

Crop establishment and health assessments:

Establishment assessments were undertaken in the cover crop and four weeks post-drilling of the spring wheat. These assessments consisted of plant counts and percentage green cover scores across fifteen 25 cm^2 sample areas in each treatment. At the end of May 2023, all wheat plants in four 25 cm^2 quadrats were extracted from across each tramline and then cut into separate above and below ground sections. Fresh and dry mass was recorded for the above and below ground material. General crop health was also monitored.

Soil health assessments:

- Soil health had been monitored in 2021 using the AHDB soil health scorecard approach. Three sampling sites were identified within each tramline. The tests were repeated in December 2022 including visual evaluation of soil structure (VESS), worm counts and laboratory analysis of the soils for broad spectrum analysis (Lancrop, YARA, Pocklington, UK).
- Soil samples were also collected from each treatment for microbial population analysis in December 2022 and under spring wheat in May 2023. These samples were submitted for microbial population analysis (SoilBioLab, Andover, UK).

Crop root assessments:

- Root metrics were recorded for spring wheat in each treatment in May 2023, including total root length and longest root length per plant. Ten wheat plants were extracted from each tramline. Total root length was calculated from the sum of the length of all primary roots of an individual plant – small secondary roots were not considered. Longest root length was calculated by recording the length of the longest primary roots of each plant.
- Samples were also submitted for analysis of mycorrhizal colonisation of the roots in May 2023. Five intact root systems were extracted from each treatment area, with rhizosphere soil retained in place on the surface of roots, and submitted for analysis of mycorrhizal root colonisation (SoilBioLab, Andover, UK). The results of this analysis of mycorrhizal root colonisation are expressed as a percentage.

Yield and harvest sample analysis:

- Average yield data was collected at harvest for each tramline in the field – each tramline was harvested individually to prevent crossover between treatments. Grain samples were also collected from each treatment during combining and were submitted for nitrogen and protein analysis at NIAB Labtest (NIAB, Cambridge, UK).

3.4. What results has the project delivered?

Crop establishment assessments:

The plant counts, undertaken in each tramline at 4, 6 and 8 weeks post-drilling of cover crops, indicated that there was no significant difference in cover crop growth between the treatments (Figure 4). This was true of all three assessment timings. There was no medium-term effect of the treatments in the autumn after they had been applied.

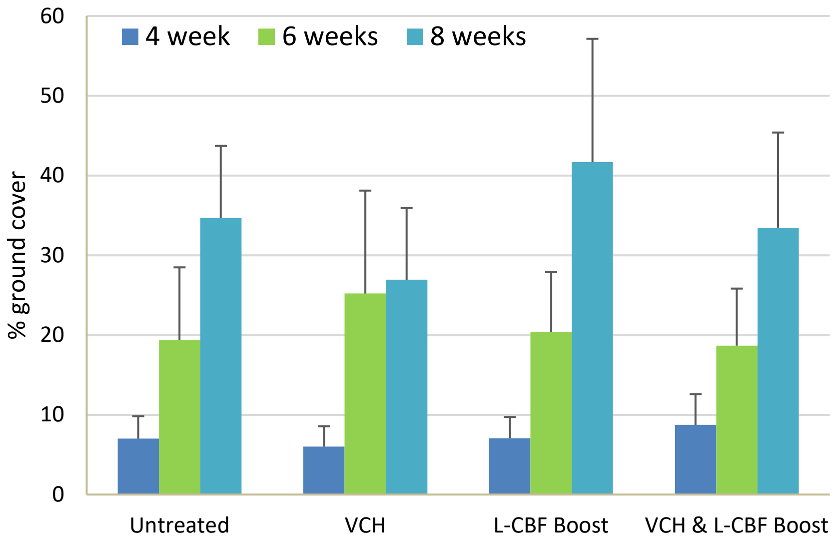

Figure 4. Comparison of groundcover of the cover crops at 4, 6 and 8 weeks post-drilling across the four tramline treatments in Fish Ponds field

The plant counts, undertaken in each tramline at four weeks post-drilling of the spring wheat (i.e also following the second treatment applications), also indicated that there was no significant difference in early crop growth between the treatments (Figure 5).

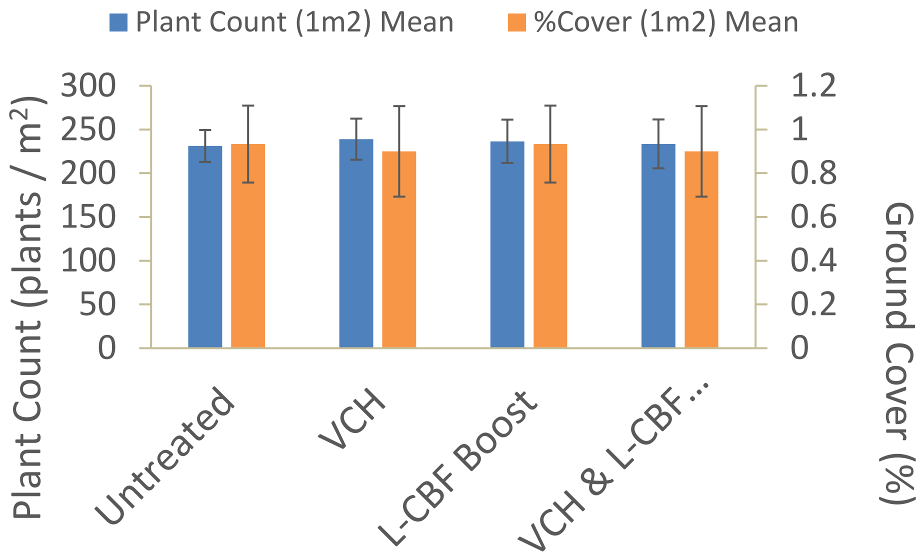

Figure 5. Comparison of plant counts and groundcover of the spring wheat at four weeks post-drilling across the four tramline treatments in Fish Ponds field

No significant disease was found in the spring wheat and there were no differences between treatments.

Root metrics

There were no significant differences detected in any root assessments in spring wheat (Table 2). Based on these metrics, the products did not appear to have significantly influenced root development.

Table 2. Average root metrics (with standard error) for spring wheat recorded for replicate samples collected on 24/05/2023 in each of the treatments in Fish Ponds field

Treatment	Total root length (cm)	SE	Root number	SE	Longest root (cm)	SE
Untreated	351.6	11.34	6.0	0.0	78.4	2.23
VCH	323.5	18.21	5.8	0.13	76.9	3.16
L-CBF Boost	398.8	20.24	6.0	0.0	91.8	4.83
VCH + L-CBF Boost	419.0	30.33	6.0	0.0	91.9	5.29

Soil health assessments:

Overall, the soil was still very well structured in all treatments, achieving a VESS score of 1–2. The aggregates were generally small and easily broken in the hand. Larger objects visible were often flints and not large soil aggregates. Given that the soil appeared equally well structured across all tramlines, the soil structure would not be expected to have significantly influenced results. Earthworm numbers were also not different between treatments, with an average of four earthworms observed for each block (20 x 20 cm). Soil pH was high (*c.* pH 8) but other soil chemical properties (P, K, Mg) were non-limiting and not different between treatments. Soil organic matter averaged 5% across the trial area with no difference between treatments.

Soil mineral N was low overwinter reflecting the biological cycling of N in the soils. Samples collected in March show the impact of fertiliser application (Figure 6). There were no significant differences between the treatments.

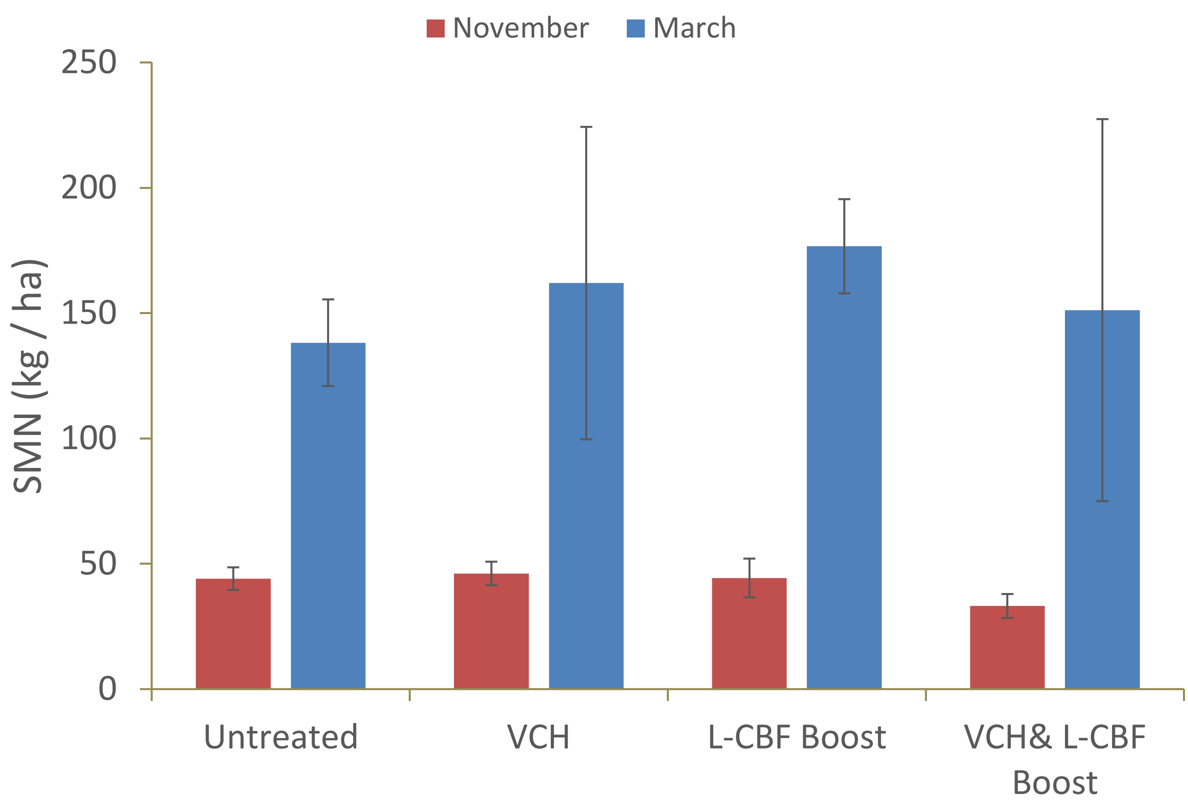

Figure 6. Soil mineral nitrogen (SMN) in topsoil for each of the four treatments in November and March**.** There were no significant differences in SMN between the different treatments. March data are affected by recent fertiliser application

Soil microbial analysis:

In December 2022, before the second application of the treatments, the soil contained good levels of bacteria and fungi (Table 3). Measured populations of bacteria and fungi were lower on average in late-May after the treatments (Table 3). There are no clear trends of differences between treatments, with the variation typical of intra-field variation. The mycorrhizal root colonisation analysis in 2023 showed lower-than-typical levels of colonisation for wheat (usually 25–30%) with no differences between treatments.

Table 3. Soil microbial populations in December 2022 (cover crop) and May 2023 (spring wheat) for each treatment. Analysis and guideline values provided by SoilBioLab (Andover, UK)

	1 Untreated		2 VCH		3 L-CBF Boost		4 VCH & L-CBF Boost		Guideline values
	Dec	May	Dec	May	Dec	May	Dec	May	
Total bacteria (µg / g)	759	479	844	378	822	505	1037	473	200-400
Total fungi (µg / g)	293	941	406	172	539	142	474	242	200-400
Fungi:bacteria Ratio	0.39	1.97	0.48	0.46	0.66	0.28	0.46	0.51	1-2
AMF root colonisation (%)	-	17.2	-	12	-	11.4	-	17.6	10-50

Yield and grain analysis:

There were no significant differences in average yield between any of the four treatments. All treatments achieved average yields of approximately 6 t/ha (Table 4). In addition, there were no differences in the protein and specific weight data between treatments.

Table 4. Average yield (t/ha) and grain quality data for treatments. Analysis provided by NIAB Labtest (Cambridge, UK)

Treatment	Average yield (t /ha)	Moisture content (%)	Specific weight (kg / hL)	Protein content (g/100g)
Untreated	6.10	14.4	75.3	11.83
VCH	6.20	14.3	75.3	11.76
L-CBF Boost	5.98	14.5	74.9	11.47
VCH + L-CBF Boost	6.21	14.5	75.0	11.52

3.5. Action points for farmers and agronomists

- The products did not have an observable influence on establishment or root development in the soil/season/crop combinations studied
- This result was probably because the long-term approaches (reduced tillage and cover cropping in combination) have improved baseline soil health on the farm
- Given the inherent variability within soils and root growth habit, anyone thinking of using (or ceasing use of) similar products should consider carrying out strip trials to support decisions
- The main monitoring strategies used in this project are straightforward, require no specialist equipment and all sample analyses are offered by commercial laboratories
- Therefore, these monitoring strategies can be used to examine the effectiveness of such products in your farming system

4. Cover crops and water quality

Trial leader: Callum Scotson and Joe Martlew, NIAB

Start date: September 2021

End date: Ongoing

4.1. Headlines

- Wheatsheaf Farming Company has used cover crops since 2010
- All spring crop ground has included a cover crop since 2015
- This project investigates the interaction between the cover crop species mix, soil health status, and health and productivity of following spring crops
- The work complements cover crop trial data collected by FWAG-South East on the farm
- The results helped to confirm that the farm's long-term decision to integrate cover crops does not have a deleterious effect on following crop health or yield
- Therefore, the selection of the most appropriate cover crop mixture can be made by considering the rate of establishment, canopy development and capacity to develop above or below ground biomass
- From the establishment and biomass results, a property to consider when selecting a cover crop mix is the rate at which species within the mix will emerge and the above/below ground biomass they provide throughout the intended growing season
- For example, where present, radish, phacelia and mustard contributed substantially to the above ground biomass

- The difference in rooting structures meant that only radish and mustard further significantly contributed to the below ground biomass
- However, the dense fibrous root network of phacelia within the top 15 cm of soil created and stabilised a distinct crumb structure
- Species that provide substantial above ground biomass were likely to provide larger canopies which, in turn, for example, could reduce the likelihood of capping
- None of the cover crop mixtures had an observable deleterious effect on spring bean establishment, health or yield
- Data collected by FWAG-South East showed reductions in nitrate leaching where cover crops were grown. However, slug numbers increased slightly in a cover crop, compared with stubble, but overall benefits for beneficial invertebrate species outweighed pest increases

4.2. What was the challenge/demand for the work?

Cover crops provide many benefits, such as improved soil structure, capturing nutrients and providing organic matter.

David is working with South East Water, FWAG-South East and Kings Crops to trial cover crops and assess impacts on diffuse pollution, soil health and biodiversity. Assessments carried out by FWAG-South East include nitrate in soil water, soil nutrients, cover crop nutrient content, slug populations, beneficial insects (pitfall traps) and soil health.

These data highlight the peak nitrate concentrations in early autumn and the role of all cover crops in reducing nitrate losses.

The reduction in nitrate losses is strongly related to groundcover. For example, the ground cover achieved by December was:

- Crops = less than 10%
- Weedy stubble = 20–30%
- Cover crops = 50–70%

However, much less is known about the patterns of below-ground biomass and impacts on the following crop. This Strategic Cereal Farm focused on filling these knowledge gaps.

4.3. How did the project address this?

Trial design

The 2022-–23 trial took place in the same fields as the 2021–22 trial but in different areas (Figure 7). The main cover crop trial took place in Slope field, with a comparator winter cropping scenario in neighbouring Workshop field (winter bean crop). Slope field contained four treatments: three areas with different cover crop seed mixes and a bare stubble area (control). Each of these areas consisted of an 18m wide strip that ran across the field (Figure 7). The cover crop seed mixes were:

- Seed Mix 1 (oats and mustard)
- Seed Mix 2 (oats, clover, radish and vetch)
- Seed Mix 3 (buckwheat, radish, linseed and phacelia)
- Stubble (control – with weeds and volunteer cereals)

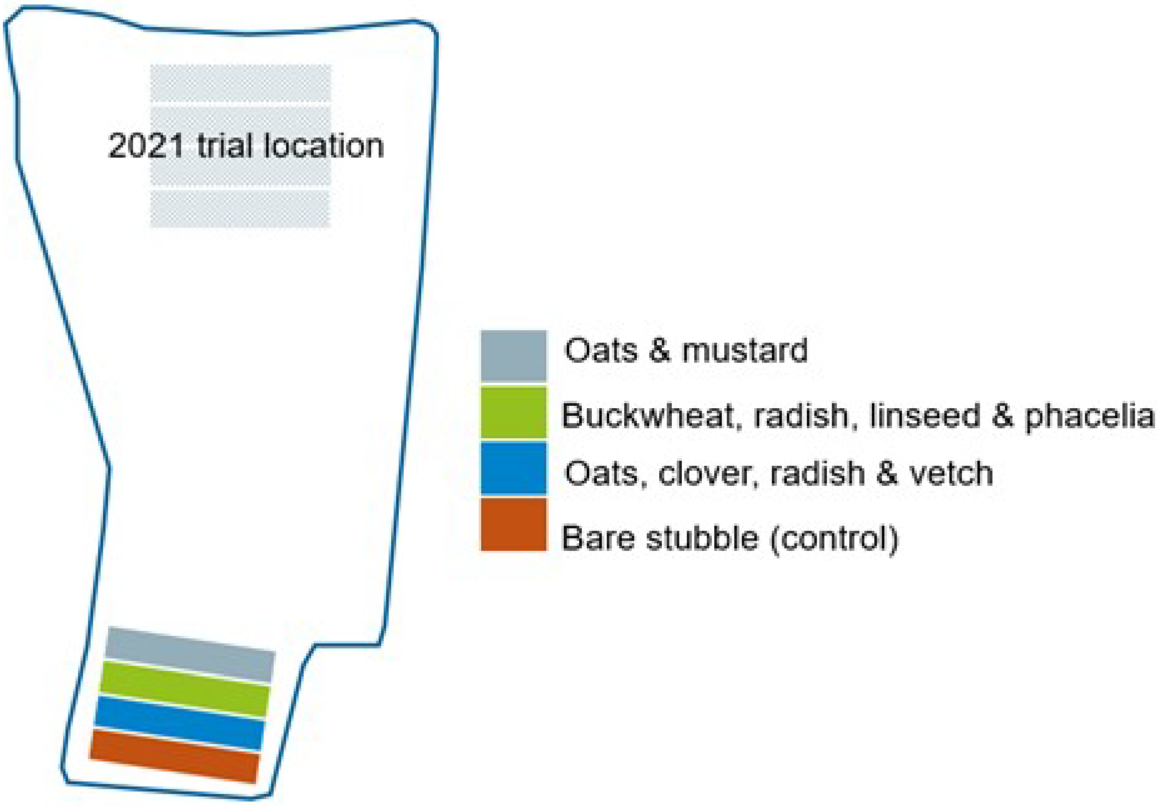

Figure 7. The layout, composition and location of the cover crop strips in Slope field

In spring 2023, cover crops were destroyed and a spring bean crop was established. The influence of the cover crop on the soil health status and productivity of the following spring bean crop was assessed during the year. These same assessments were undertaken in the winter bean crop in Workshop field to provide a comparison.

Assessments

Crop establishment and health assessments:

Establishment assessments, consisting of plant counts and percentage green cover scores, were undertaken on both the cover crop areas in Slope field and the winter beans in Workshop field at 4, 6 and 8 weeks post-drilling of the winter beans. These assessments were conducted across fifteen 25 cm^2 quadrats in each cover crop area and in the winter beans in Workshop field.

The above and below ground biomass was recorded for each cover crop strip and for the winter beans in Workshop field. All plants were extracted from four 25 cm^2 quadrats in each strip, in addition to the winter beans in Workshop field. The plants were sorted by species and cut into above and below ground sections. Fresh and dry mass was recorded for above and below ground material of each constituent species of the mix, as well as any weed species present.

Soil samples were collected from sampling sites across the four cover crop strips in Slope field as well as from sites in Workshop field in November 2022 and March 2023. These samples were then immediately submitted for mineral nitrogen analysis (Lancrop, YARA, Pocklington, UK). Following destruction of the cover crops and drilling of the spring beans, establishment was assessed at six weeks post-drilling. Crop health was monitored throughout the season.

Soil health assessments:

Soil health assessments were undertaken using a soil health scorecard approach, which included visual evaluation of soil structure (VESS), worm counts and laboratory analysis. Three sampling sites were identified within each cover crop treatment strip in Slope field, in addition to three sampling sites located in the winter beans in Workshop field. Additional soil samples were collected from the sampling sites in November 2022 and in March 2023 for soil mineral nitrogen analysis (Lancrop, YARA, Pocklington, UK).

Yield and harvest sample analysis:

Yield data was collected from the combine yield maps at harvest for the winter beans in Workshop field and for spring beans from each of the cover crop strips in Slope field. The strips of spring beans in each of the former cover crop areas were harvested individually to prevent crossover. Grain samples were also collected at harvest from four points of each cover crop treatment area in addition to four areas of Workshop field. These grain samples were submitted for nitrogen and protein analysis (NIAB Labtest, Cambridge, UK).

4.4. What results has the project delivered?

Crop establishment assessments:

Mix 2 (oats, clover, radish and vetch) established quickest, with rapid groundcover developing (Figure 8), closely followed by mix 3 (buckwheat, radish, linseed and phacelia). Mix 1 (oats and mustard) and the wheat volunteers in the stubble were slower to establish. The winter beans in Workshop barely achieved 5% ground cover eight weeks after drilling (Figure 8).

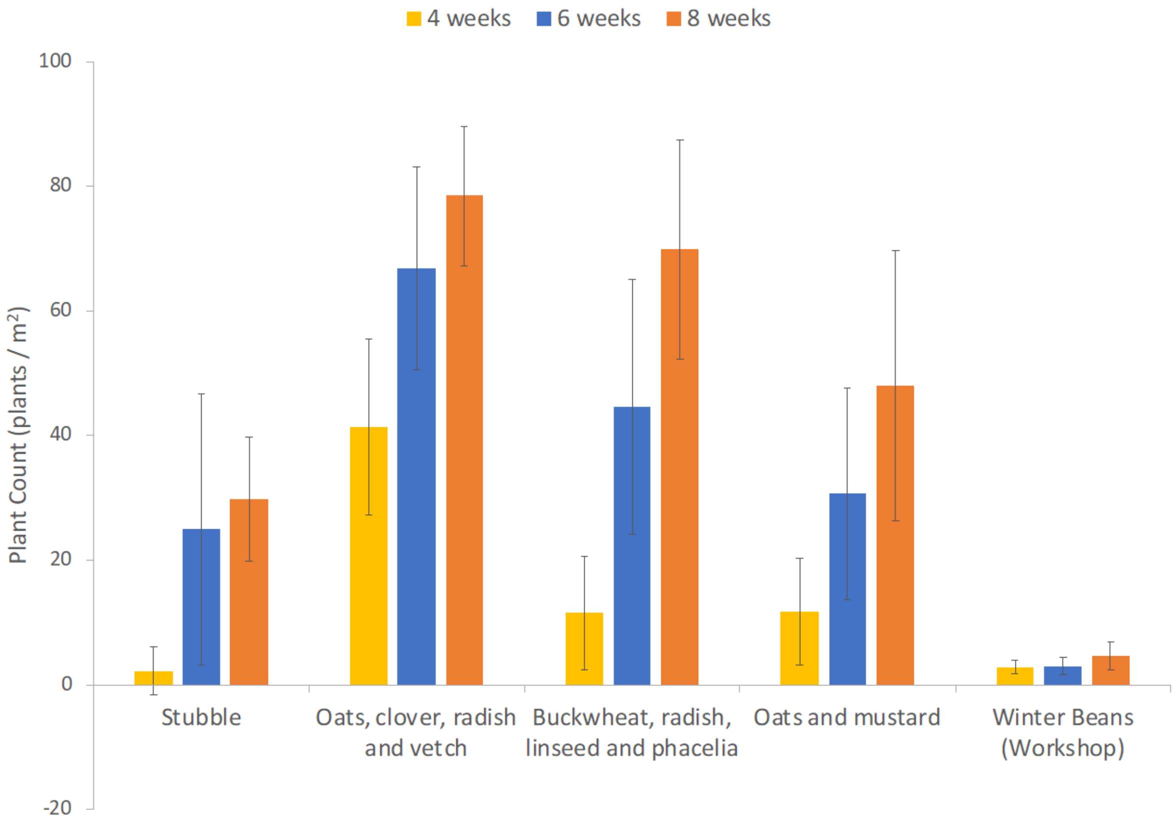

Figure 8. Comparison of percentage green cover across the four different cover crop strips in Slope field in comparison with the winter beans in the neighbouring field (Workshop). Error bars display the standard deviation

Cover crop biomass:

Where present, oil radish, mustard, oats and phacelia contributed substantially to the above ground biomass (Figure 9). The difference in rooting structures meant that only radish and mustard further significantly contributed to the below ground biomass (Figure 10). However, the dense fibrous root network of phacelia within the top 15 cm of soil created and stabilised a distinct crumb structure. Species that provide substantial above ground biomass were likely to provide larger canopies which, in turn could, for example, reduce the likelihood of capping. This was also observed in the previous year. In winter 2022–23, considerably less biomass was provided by cereal volunteers in the stubble compared with overwinter 2021–22.

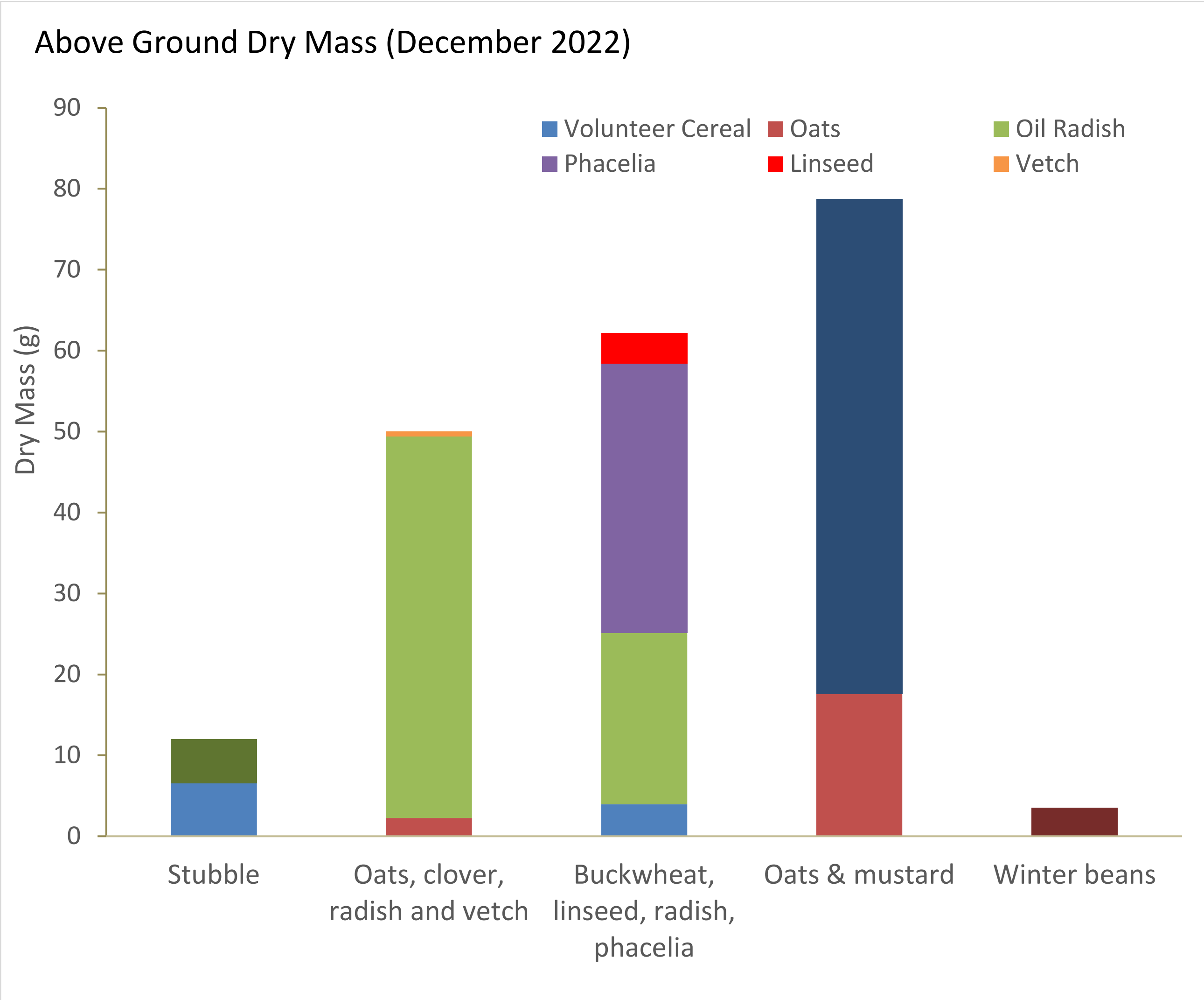

Figure 9. Above ground dry mass (g / m^2) for the constituent plants of the different cover crop seed mix areas

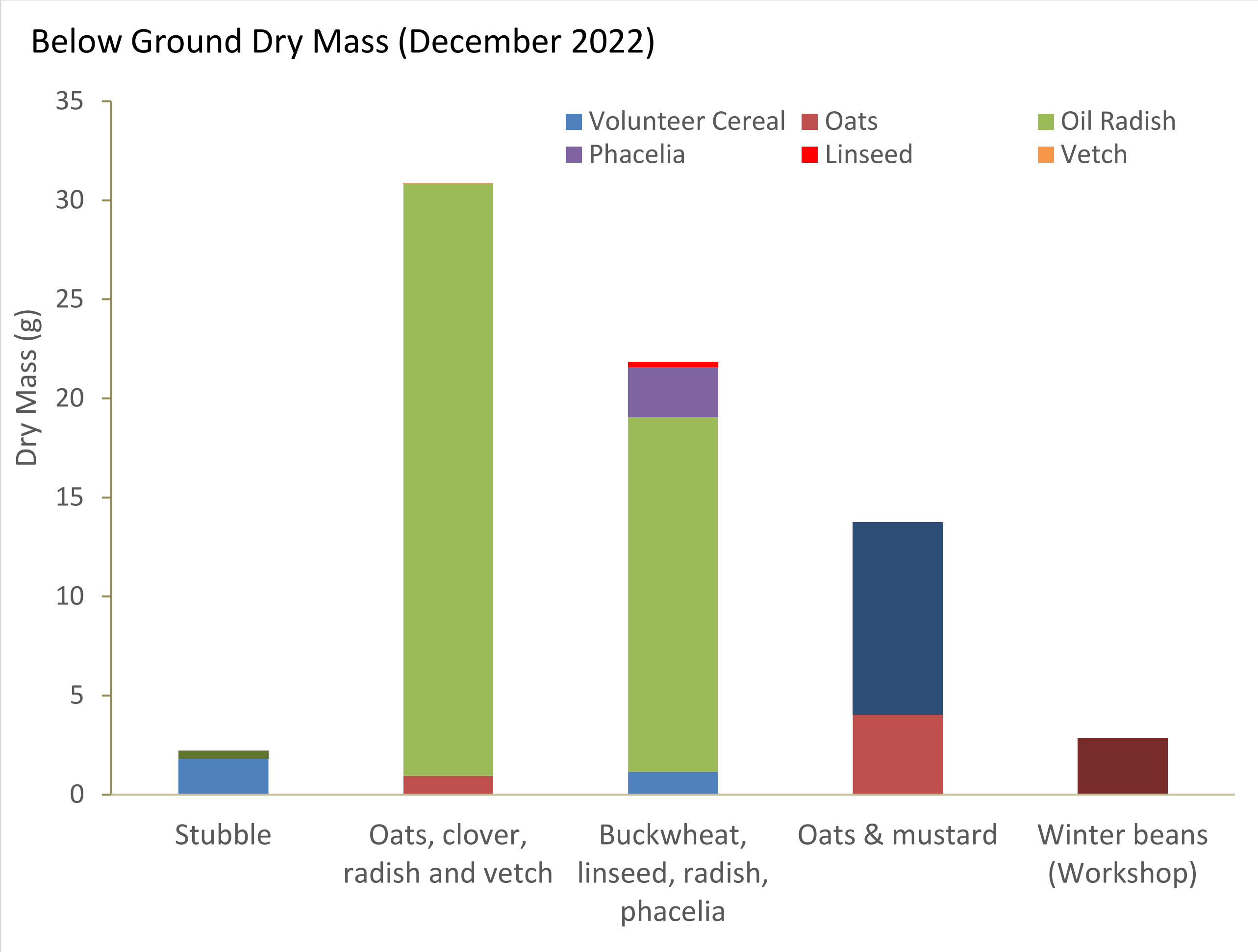

Figure 10. Below ground dry mass (g / m^2) for the constituent plants of the different cover crop seed mix areas

VESS assessments were carried out towards the end of the cover cropping period (Figure 11) to provide insights into the condition of the soil. The soil within the cover crop strips in Slope field and the winter beans in Workshop field was generally well structured (Figure 11). The areas containing cover crops received average VESS scores of 1, while the strip containing bare stubble and the winter beans in Workshop field received average VESS scores of 2. Considerable soil cohesion was observed at the surface in the cover crop plots, where the soil surface was held together by roots. However, though still well structured, the soil surface cohesion in the 'bare stubble' area was poorer – owing to the lack of roots to retain the soil in place. It was noted that the photos collected during VESS assessment provided useful information on rooting patterns and impacts, similar to that provided by the more complex (and costly) detailed sampling. Hence for on-farm monitoring it is suggested that VESS assessments (with photos) should be used as the main way of monitoring differences in rooting patterns and their impacts on soil structure.

a) Winter beans

b) Bare stubble

c) Seed Mix 1 (oats and mustard)

d) Seed Mix 2 (oats, clover, radish and vetch)

e) Seed Mix 3 (buckwheat, radish, linseed and phacelia)

Figure 11. Photographs collected as part of the VESS process highlighting the differences in rooting patterns and their impacts on soil structure

Soil mineral nitrogen:

Significant differences in soil mineral N occurred in November 2022 (Figure 12). Within Slope Field following spring wheat, the cover crop with mix 3 (buckwheat, radish, linseed and phacelia) had significantly lower soil mineral N compared with stubble and mix 1 (oats and mustard). Workshop Field (following winter wheat) also had lower soil mineral N in November 2022. There were no significant differences in soil mineral N in March 2023 (Figure 12).

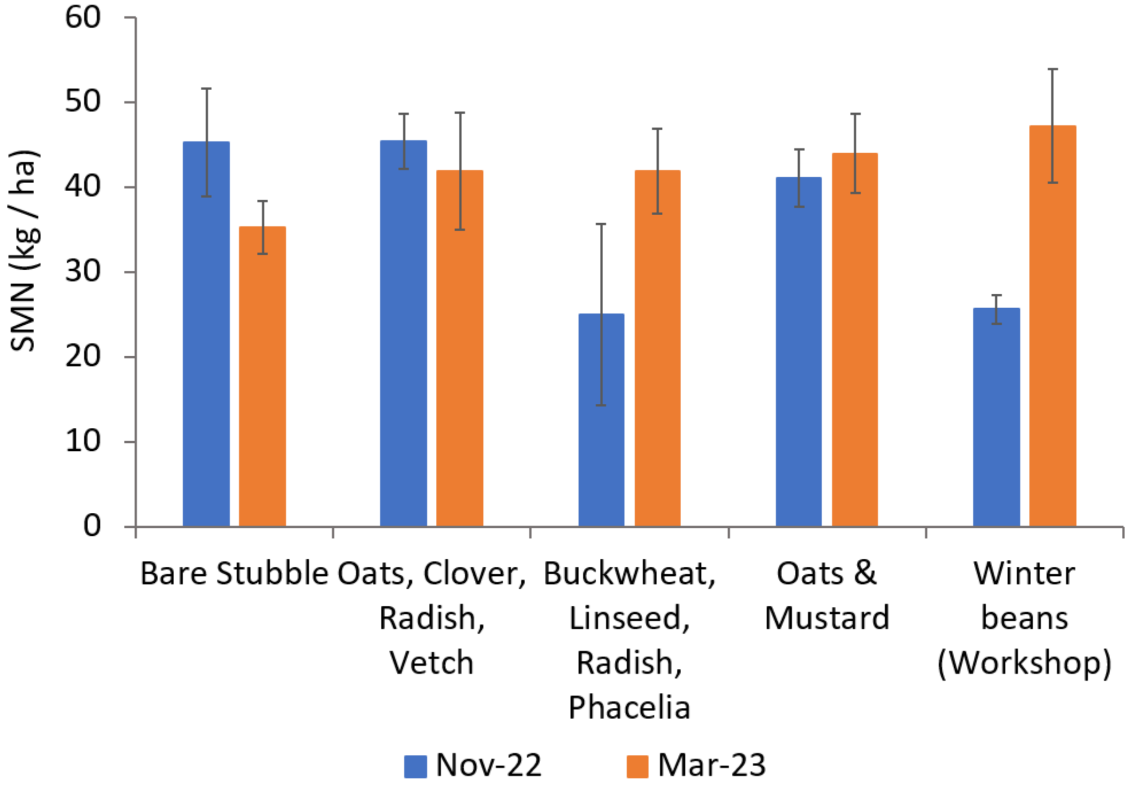

Figure 12. Soil mineral nitrogen (SMN) content measured in soil samples from each of the four treatments in Slope Field and the comparator winter crop in Workshop field in November and March

Crop health, yield and grain analysis:

There were no significant differences in crop emergence and establishment of spring beans across all the former cover crop strips (Figure 13). None of the cover crops significantly influenced the establishment of the following spring crop.

There were no major pest or disease pressures and the cover crops did not appear to observably influence crop health in the following spring beans.

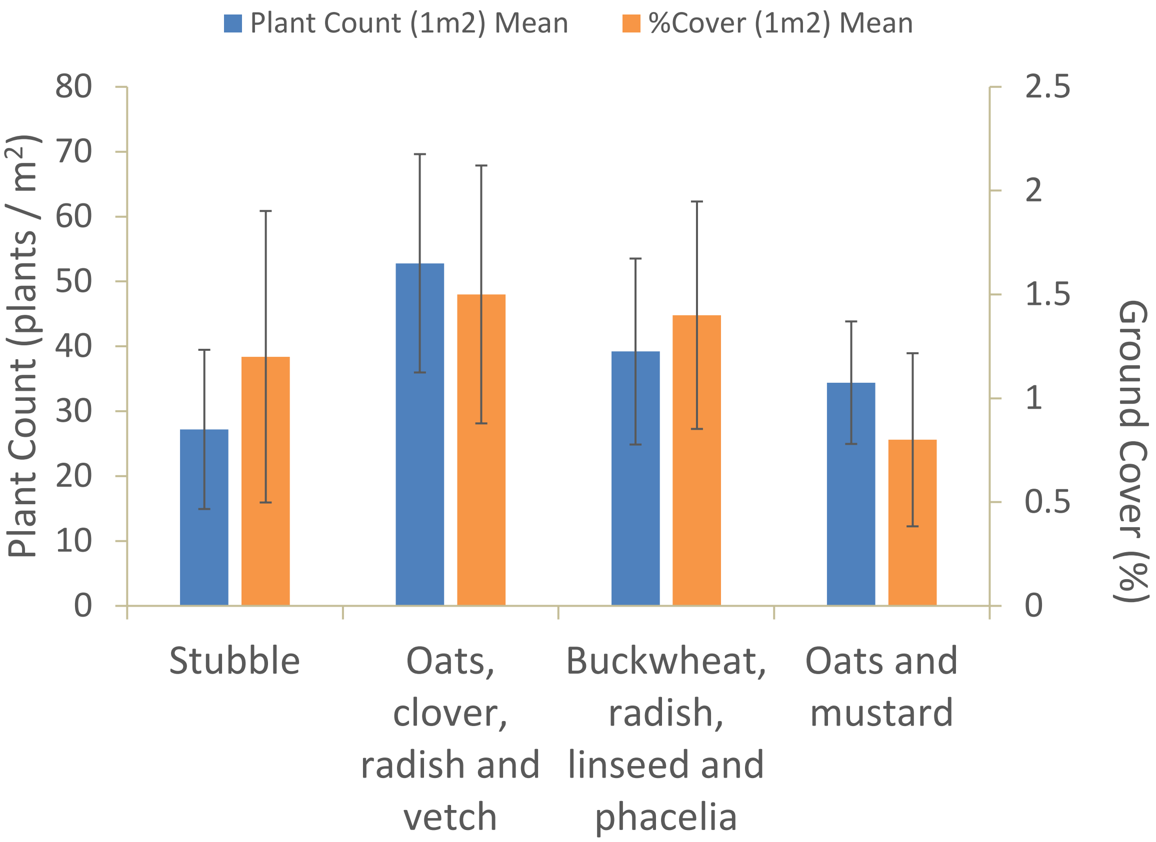

Figure 13. Comparison of plant counts and groundcover of the spring beans at 6 weeks post-drilling across the four cover crop treatments in Slope field

The yield of the winter beans in Workshop field was significantly greater than that of the spring beans in any area of Slope field, as would be expected (Table 5). Within Slope field, the yield was not significantly different between the different zones of previous cover cropping. There was also a slight trend that suggested higher protein content following cover crop mix treatments compared with bare stubble (Table 5).

Table 5. Average yield (t/ha) and grain quality data for spring beans following cover crop treatments. Analysis provided by NIAB Labtest (Cambridge, UK)

Treatment	Average yield (t /ha)	Moisture content (%)	Protein content (g/100g)
Winter cropping (winter beans)	2.2	14.0	26.75
Seed Mix 1 (oats and mustard)	1.1	13.5	30.26
Seed Mix 2 (oats, clover, radish and vetch)	1.2	13.9	31.66
Seed Mix 3 (buckwheat, radish, linseed and phacelia)	1.1	14.0	30.91
Stubble; control (weeds and volunteer cereals)	1.2	14.1	28.90

4.5. Action points for farmers and agronomists

- The work confirmed that the farm's long-term decision to integrate cover crops on these light/medium soils does not have a deleterious effect on following crop health or yield
- Integration of cover crops is not expected to be as straightforward on heavy soils
- Selection of the most appropriate cover crop mixture for any site should consider the rate of establishment, canopy development and capacity to develop above-ground or below-ground biomass with regard to the expect drilling date
- For example, it was observed that early-season green cover and canopy development varied between mixes and that various species made different contributions to above-ground and below-ground biomass production
- For on-farm monitoring, consider using VESS assessments (with photos) to monitor rooting patterns and soil structure impacts