Grower Summary

Asparagus: Sustainable soil management for stand longevity and yield optimization

Final report 2021

Project title:	Asparagus: Sustainable soil management for stand longevity and yield optimization
Project number:	FV 450a
Project leader:	Dr Rob Simmons, Cranfield University
Report:	Final Report, July 2021
Previous reports:	Annual Report, September 2020 Annual Report, July 2019
Key staff:	Lucie Maskova and Dr Lynda Deeks
Location of project:	Gatsford, Ross-on-Wye
Date project commenced:	01/03/2018
Date project completed (or expected completion date):	31/05/2021

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The results and conclusions in this report are based on an investigation conducted over a three-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Dr Lynda Deeks

Research Fellow in Soil Science

Cranfield University

Signature .... Date ...01-09-21....

Report authorised by:

Dr Robert Simmons

Reader in Sustainable Soil Management

Cranfield University

GROWER SUMMARY

Headlines

- The results of this study confirm that asparagus yield, profitability, alleviation of soil compaction, increased infiltration and improved soil health can be achieved by moving away from conventional practice and adopting one of several alternative Best Management Practice (BMP) options.
- PAS 100 Compost applied annually to asparagus interrows in combination with shallow soil disturbance (SSD) without annual re-ridging can result in significant (>20%) yield uplift, reduced soil compaction, improved infiltration rates and improved profitability as compared to conventional practice.
- Companion cropping with rye (*Secale cereale*) with annual re-ridging, can result in >20% yield uplift as compared to conventional practice. However, non-ridging carries a risk of a 20% yield penalty compared with conventional practice suggesting that growers need to be confident that they can re-ridge if rye is grown as a companion crop for run-off and erosion control.
- Zero-tillage also referred to as 'ridging for the life of the crop' is associated with improved yield and profitability, reduced soil compaction and improved soil health as compared with conventional practice.
- The FV 450a trial has not yet reached the key phase of crop maturity and economic production which typically occurs between years 4-7. This is the key payback period for growers. Consequently, the impact of BMPs on stand longevity and profitability will continued to be monitored and economic implications assessed.

Background

Conventional operations associated with UK asparagus production, i.e., tillage operations, such as ridging and sub-soiling, spray operations, harvesting (foot-trafficked and/or hand harvested using picking rigs) can result in progressive and severe compaction of all inter-bed wheelings. In addition, research undertaken over the last 20 years has demonstrated that root damage associated with annual re-ridging has a major impact on stand longevity and productivity and increases the susceptibility to crown and root rots caused by *Phytophthora* and *Fusarium* species.

Further, compaction of wheelings leads to a significant reduction in infiltration resulting in an increased risk of surface water ponding and on sloping land, run-off generation and erosion. In turn, surface water ponding and/or erosion compromises field operations by restricting foot and vehicular traffic, and water ponding in furrows increases the risk of crown and root rots

leading to yield decline. The long-term field trials established under this project have evaluated a range of best management practices (BMPs) to prevent and/or mitigate compaction, improve soil structural status in asparagus wheelings and facilitate long-term profitability of asparagus production.

Summary

This report represents the culmination of five years of research activities initiated in 2016 under FV 450 and continued until the end of June 2021 under FV 450a (Figure 1). Continued monitoring of the FV450/450a field trial will continue under FV 450b.

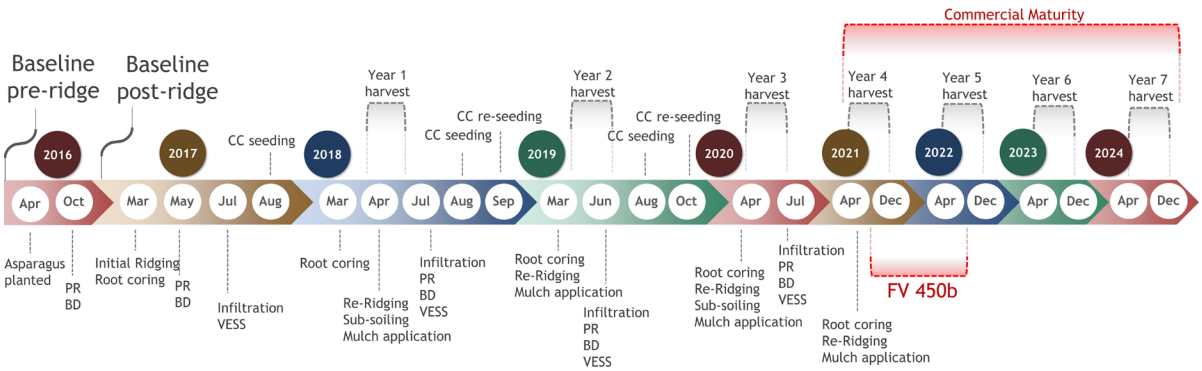

Figure 1. FV 450 / FV 450a project timeline indicating activities undertaken to date and period of commercial maturity.

Performance of Best Management Practices (BMPs) as compared with conventional Practice

Based on the key metrics measured in the 2020 cropping season (5-year-old asparagus stand) a comparative treatment performance evaluation was undertaken to identify BMPs with the most desirable overall impact across multiple performance indicators in comparison with conventional practice (Figure 2). See Appendix A of Science Section for detailed performance score calculation methodology.

Throughout this research, conventional practice is defined as asparagus grown with bare soil interrows that is ridged on an annual basis without shallow soil disturbance (SSD) applied to the inter-rows (Bare soil No-SSD R). Zero-tillage is defined as asparagus grown with bare soil interrows without any annual re-ridging applied after April 2017 or SSD applied to interrows.

Performance indicators used in this performance assessment included Root Mass Density (RMD), yield, spear size, potential profitability, total storage root soluble carbohydrate (CHO), soil compaction as measured by penetrative resistance (PR) and soil infiltration rates. Final (un-weighted) comparative performance scores range between 2.5 and 9.1. Values close to zero indicate management practices that carry a major risk to the asparagus root growth, yield, productivity and soil erosion risk. In contrast, BMP treatments with values close to 10 infer management practices that promote asparagus root growth, yield, productivity and reduce soil erosion risk.

Relative performance scores indicate that the application of the conventional practice with a performance score of 2.5 carries the highest overall risk to asparagus root growth, yield, productivity, soil erosion risk and consequently asparagus stand longevity. Figure 2 indicates that all BMP treatments evaluated under FV 450a (with the exception of rye non-ridged companion crop) are an improvement on conventional practice, suggesting they could be adopted to drive a major change in the way asparagus is cultivated in the UK. The highest performance scores of 7.0 to 9.1 are primarily linked to the application of straw and PAS 100 mulches to asparagus interrows at 5 and 25 t ha^{-1} per annum respectively in association with interrow shallow soil disturbance and post-mulch application. These BMPs promoted improvements in asparagus root growth, yield, profitability, promoted soil health and reduced soil erosion risk. It is however recommended that growers keep up to date with regulations pertaining to the application of PAS 100 compost to land to ensure that they are compliant.

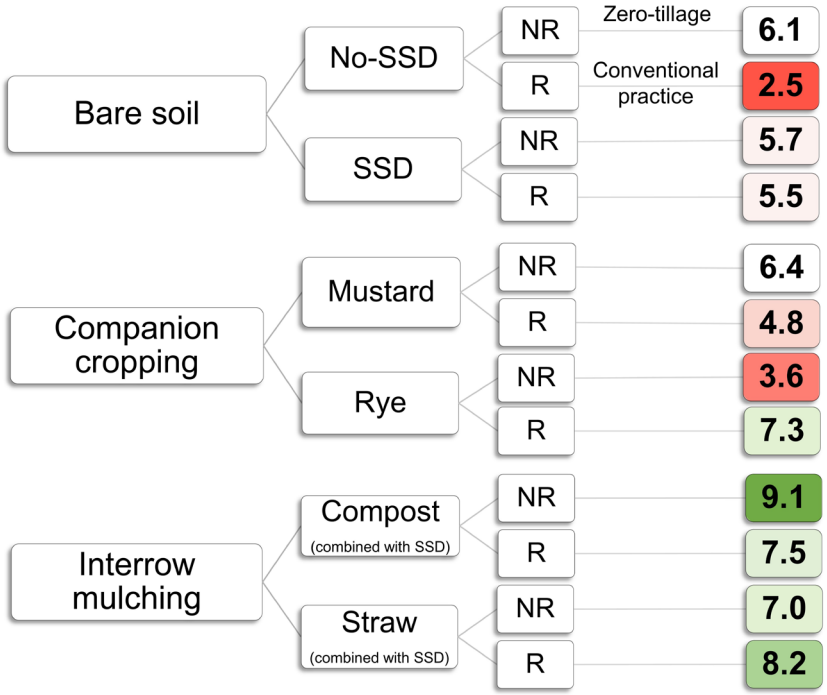

Figure 2. Comparison of asparagus crop performance associated with different management practices applied from 2016-2020. Performance scores range from 0 (worst) to 10 (best).. NR = No annual re-ridging. R = Annual re-ridging, SSD = shallow soil disturbance applied to interrows.

Financial Benefits

This project has provided information on the state of asparagus soils and provides focused, practical and robust guidance on how to identify and alleviate compaction and water-logging in asparagus interrows, thereby reducing the risk of asparagus decline, increasing asparagus yields and farm profitability, while minimising environmental impact. In addition, this project has also provided research outcomes that can feed directly into policy discussions associated with the Environmental Land Management scheme (ELMS) scheme such that asparagus growers can receive 'financial reward in return for delivering environmental benefits'.

An initial cost-benefit analysis for the 2020 harvest demonstrated potential revenue increases of 28-30% and 18% respectively for PAS 100 mulch with shallow soil disturbance (ridged and non-ridged) and zero tillage. Similarly, there was a potential revenue increase for Gijnlim and Guelph Millenium for zero tillage versus conventional practice of 19% and 25% respectively. A more detailed cost-benefit analysis will be done as part of FV 450b.

Action Points

1. In order to prevent storage root damage through re-ridging or subsoiling operations, growers should undertake exploratory root profile distribution surveys prior to commencing re-ridging and/or sub-soiling operations. Guidance on how to undertake asparagus root coring can be found at: https://www.youtube.com/watch?v=Lms3GfRgiXM.
2. Compost and mulches: Use PAS 100 compost and straw mulch treatments in combination with shallow soil disturbance to significantly reduce soil compaction to 0.5 m depth as compared with conventional practice. This will result in improved infiltration, soil moisture recharge and reduced run-off and erosion risk.

