# Grower Summary

**FV 450a**

**Asparagus: Sustainable soil management for stand longevity and yield optimization**

Annual Report, April 2019

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| **Project title:** | **Asparagus: Sustainable soil management for stand longevity and yield optimization** |
| **Project number:** | FV 450a |
| **Project leader:** | Dr Rob Simmons, Cranfield University |
| **Report:** | Annual Report, April 2019 |
| **Previous report:** | Final Report FV 450, 2018 |
| **Key staff:** | Dr Sarah De Baets and Lucie Maskova |
| **Location of project:** | Gatsford, Ross-on-Wye |
| **Industry Representative:** | Phil Langley<br>Sandfield Farms |
| **Date project commenced:** | 01/03/2018 |

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*The results and conclusions in this report are based on an investigation conducted over a one-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 Robert Simmons

Senior Lecturer Sustainable Soil Management

Cranfield University

Signature .....  ..... Date ....11-07-19....

Dr Sarah De Baets

Lecturer in Plant Systems

Cranfield University

Signature ..... Date .....

**Report authorised by:**

Prof. Andrew Thompson

Head of Cranfield Soil and Agrifood Institute

Cranfield University

Signature ..... Date .....

# GROWER SUMMARY

## Headlines

- In long-term field trials (planted 2016), there were no significant differences in pre-harvest asparagus root carbohydrate levels from different soil management treatments in 2019. Significantly higher root carbohydrate levels were observed for variety Gijnlim as compared with Guelph Millennium treatments.
- Findings from a survey of root architecture in UK asparagus fields showed that annual re-ridging has the potential to damage between 5-14% of the total root biomass annually, with implications for increased disease risk and reduced stand longevity.
- Using data from twelve asparagus fields, preliminary guidelines have been developed to relate sub-soiling operations with potential risk of root damage for different asparagus varieties, soil depths and row spacings.

## Background

Conventional operations associated with UK asparagus production, i.e. tillage operations, such as ridging and sub-soiling, spray operations and harvesting, 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. Both root damage and crown and root rots significantly contribute to yield decline.

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, while 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 will evaluate a range of best management practices to prevent and/or mitigate compaction, improve soil structural status in asparagus wheelings and facilitate long-term profitability of asparagus production. The experimental trials are comparing shallow soil disturbance (SSD) and mulch attenuation options, cover/companion cropping, and non-till options against conventional practice. A further objective is to increase the relevance of potential best management practices by critically evaluating the asparagus root system architecture associated with the wider UK asparagus grower land bank, and cropping practices.

## Summary

In April 2016 two replicated field experiments were established at Gatsford Farm, Ross-on-Wye within a 4.5 ha asparagus field. Asparagus 'A' crowns of both Gijnlim and Guelph Millennium were planted on 20-21st of April 2016 on the flat at an intended depth of 0.14 m at 0.16 m spacing between crowns on 1.83 m wide bed centres. For full detail of the treatments investigated and results to date refer to AHDB FV 450 Final Report (AHDB, 2018).

Experiment 1 (48 experimental plots) is restricted to Gijnlim which represents 70% of UK field grown asparagus.

Experiment 1: Treatment descriptions

| Variety | Treatment description | Re-ridging |
|---|---|---|
| Gijnlim | Companion Crop - rye | R |
| Gijnlim | Companion Crop – rye | Non-R |
| Gijnlim | Companion Crop – mustard | R |
| Gijnlim | Companion Crop – mustard | Non-R |
| Gijnlim | PAS 100_SSD | R |
| Gijnlim | PAS 100_SSD | Non-R |
| Gijnlim | Straw Mulch_SSD | R |
| Gijnlim | Straw Mulch_SSD | Non-R |
| Gijnlim | Bare soil_SSD | R |
| Gijnlim | Bare soil_SSD | Non-R |
| Gijnlim | Bare soil_No-SSD | R |
| Gijnlim | Bare soil_No-SSD | Non-R |

Annual re-ridging (R) or Zero-ridging (Non-R). Shallow soil disturbance (SSD). Treatments highlighted in green are included in Experiment 2.

Experiment 2 compares varietal differences in root development/architecture and root profile distribution as affected by sub-soiling treatments for two widely grown varieties, Gijnlim and Guelph Millennium.

Experiment 2: Treatment descriptions

| Variety | Treatment description | Re-ridging |
|---|---|---|
| Gijnlim | Bare soil_SSD | R |
| Gijnlim | Bare soil_SSD | Non-R |
| Gijnlim | Bare soil_No-SSD | R |
| Gijnlim | Bare soil_No-SSD | Non-R |
| Millennium | Bare soil_SSD | R |
| Millennium | Bare soil_SSD | Non-R |
| Millennium | Bare soil_No-SSD | R |
| Millennium | Bare soil_No-SSD | Non-R |

Annual re-ridging (R) or Zero-ridging (Non-R). Shallow soil disturbance (SSD). Treatments highlighted in green are included from Experiment 1.

*Mulch treatments*

In April 2018, PAS 100 compost and straw were applied to three wheelings per treatment (central wheeling and guard rows) at a rate of 25 t $ha^{-1}$ and 6 t $ha^{-1}$, respectively. Shallow soil disturbance (SSD) was applied using a winged tine. In 2019, the same mulch treatments were re-applied on 19th March 2019.

*Shallow soil disturbance (SSD) treatments*

In April 2018 SSD was applied using a winged tine at 0.25 - 0.3 m depth with occasional asparagus root damage observed behind the tine. In 2019, SSD treatments will be applied post-harvest in *circa* June.

*Companion Crop treatments*

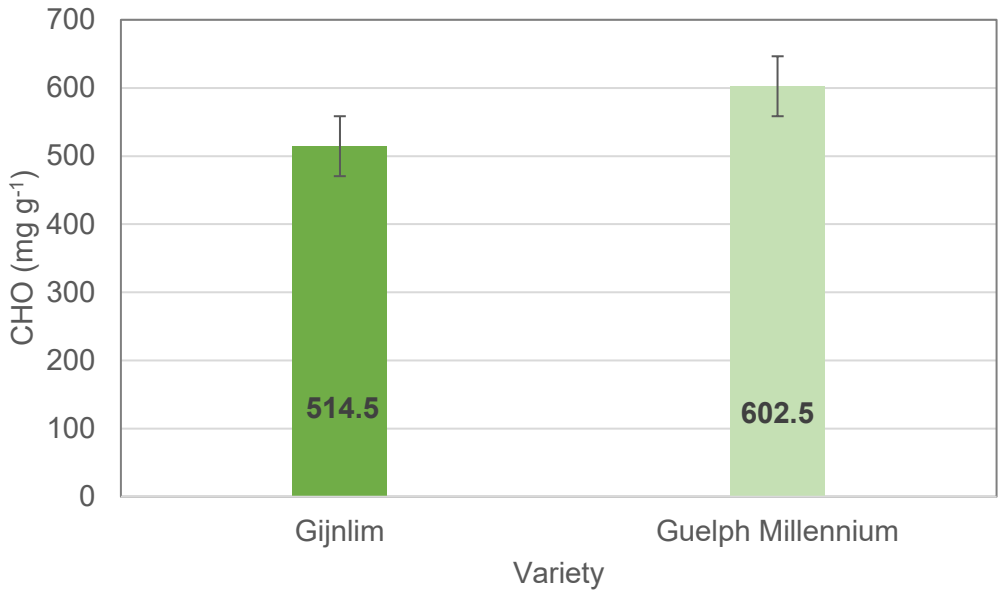
In August 2018, companion crops rye (*Cereale secale* L var. Protector) and mustard (*Sinapis alba* L. var. Severka).were sown at rates of 150 kg $ha^{-1}$ and 19 kg $ha^{-1}$, respectively to three wheelings (central wheeling and guard rows). However, the dry summer of 2018 limited emergence and establishment of both companion crops. Consequently, they were re-applied in late September 2018. A field survey in November 2018 indicated spatially sporadic but good establishment in treated plots.

*Annual re-ridging treatments*

In 2018, re-ridging treatments were applied in April 2018. In 2019, re-ridging treatments were applied on the 15th of March 2019. In both 2018 and 2019 minor root damage was observed during re-ridging.

**Impact of best management practices (BMPs) on root soluble carbohydrate (CHO) levels, 2019.**

- No significant differences in asparagus storage root CHO (mg $g^{-1}$) were observed between treatments. Across all treatments mean pre-harvest storage root CHO values at the Crown Zero Line ranged from 507 – 631 mg $g^{-1}$. This is within the upper target range outlined from previous research, indicating adequate CHO levels for optimum harvest. Yield implications for the 2019 harvest will be reported in the next annual report.
- CHO values obtained from Guelph Millennium treatments at the 0.3 m distance from the crown were significantly ($p < 0.01$) higher as compared to the equivalent for Gijnlim with mean values of 514.5 and 602.5 mg $g^{-1}$, respectively. For Guelph Millennium, this exceeds the mean CHO values reported under FV 271 (AHDB, 2007) which were dominated by Gijnlim. The implications of this will be investigated under the PhD of Lucie Maskova.




**Soil structure assessments**

- The 2018 soil structural assessments indicate that significant differences in penetrative resistance (PR) are emerging between treatments. Specifically, at both 0-5 and 5-10 cm depth, the two companion crop treatments and the bare soil_No-SSD treatment, both ridged or non-ridged, were associated with significantly higher penetrative resistance (PR) as compared with 2016 baseline measurements. The implication of this is that the companion crop treatments are negatively affecting soil structure. However, no significant difference in bulk density (BD) in the mid-topsoil depth was observed between treatments and the 2016 Baseline. The higher PR values observed for the two companion crop treatments is likely to be due to lower soil moisture content.

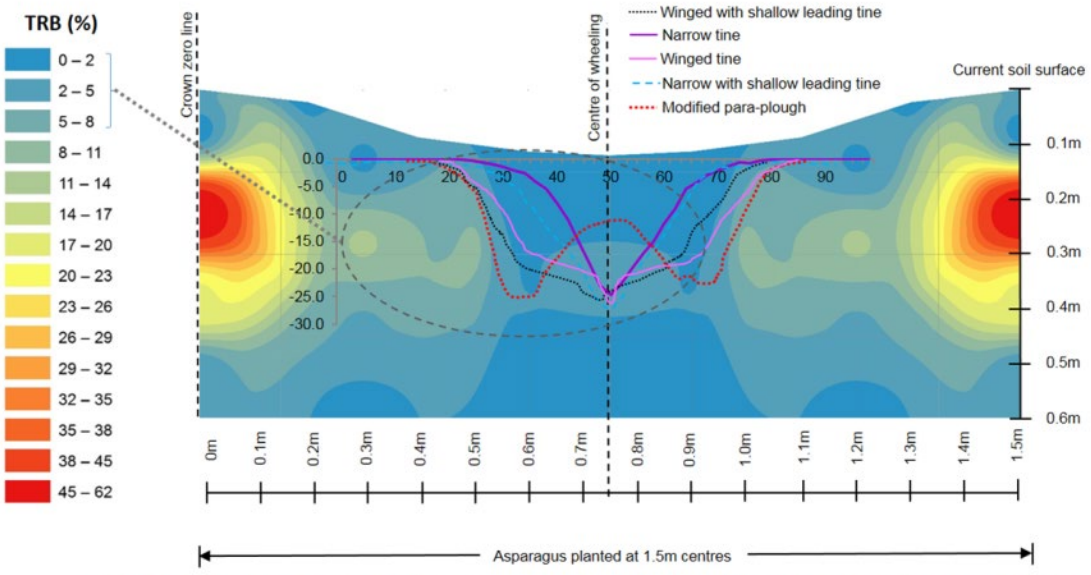
**Wider Grower Landbank: *Potential impact of sub-soiling and ridging operations on root damage.***

In February 2018, an online questionnaire with supporting information was distributed to AGA members via British Growers. The objective of this questionnaire was to obtain information pertinent to the selection of fields to be included in a wider grower root architecture survey. A wide range of detailed information was gathered on cropping and soil management practices. The questionnaire was completed by 14 AGA members and included 187 fields (>1100 ha) with a geographical spread that covers Yorkshire, Warwickshire, Hampshire, Lincolnshire, Kent, Worcestershire, Suffolk, Oxfordshire, Shropshire, Norfolk, Gloucestershire and Herefordshire. To date a total of twelve fields have been sampled from three growers. A larger sampling campaign with the support of several growers will be undertaken in spring 2019.

- Across all row spacings, age of stand, varieties, and planting method sampled, annual re-ridging operations if undertaken within 0.3 – 0.4 m of the crown zero line to depths of 0.15 m have the potential to damage between 5-14% of the Total Root Biomass (TRB). This has significant implications with regards increasing the risk of crown and root rot caused by *Phytophthora* and *Fusarium* species. This has wider significance to CHO storage potential as it is truncating root length to <0.4m.
- For asparagus grown on 1.5-1.52 m row spacings, across all ages of stand, varieties, and planting method sampled, sub-soiling operations undertaken in the centre of the wheeling at 150 mm depth using a modified para-plough risk damaging  up to 8-11% of TRB (See example below).

**Grower A Field 5**

| Year Planted | Variety | Establishment method | Row spacing (m) |
|---|---|---|---|
| 2013 | Guelph Millennium | A Crowns | 1.5 |




*Source: Niziolomski et al. (2016) Tine options for alleviating compaction in wheelings. Soil and Tillage Research, Vol. 161, pp 47-52.
Note: Horizontal axis indicates the mean horizontal disturbance (cm): Vertical axis indicates the mean vertical al disturbance (cm)

- For asparagus grown on 1.5-1.52 m row spacings, across all ages of stand, varieties, and planting method sampled, sub-soiling operations undertaken in the centre of the wheeling at 150 mm depth using a winged with shallow leading tine, narrow tine, winged tine and narrow shallow leading tines of configurations investigated by Niziolomski et al. (2016) are in general associated with <2% damage to TRB.

- For asparagus grown on 2.0 m row spacings, for 2-year old Guelph Millennium and Gijnlim and 1-year old Mondeo planted as modules, sub-soiling operations can be undertaken in the centre of the wheeling from 150-300 mm depth using the tines configurations investigated by Niziolomski et al. (2016) with the risk of damaging <2% damage to TRB.

- For Gijnlim planted as A-crowns, on 2.0 m row spacing, sub-soiling operations undertaken in the centre of the wheeling from 150-300 mm depth using the tines configurations investigated by Niziolomski et al. (2016) risk damaging 2-5% of TRB.

## Financial Benefits

During 2005 – 2017 the area under asparagus cultivation in the UK increased from 890 – 2479 ha (>270%). In addition, during 2005 – 2015 British asparagus production during the traditional growing season (April-June) increased by >260% (2,050 t to 5,434 t). The ex-farm value of British asparagus in 2005 was circa £5.7 Million and in 2014, £27.6 Million. UK imports during the British season (April to June 2015) of 2,396 t, is valued at £8.4 million. Annual asparagus imports to the UK in 2014 amounted to 14,200 t, valued at £46.8 million. The potential for UK grown asparagus production to expand is significant.

However, over a 10-year cropping cycle, asparagus decline largely attributed to *Fusarium* and *Phythophtora* species can result in up to 60% loss of stand amounting to up to £16M in lost revenue per annum. A 10% reduction in yield losses due to asparagus decline would amount to a saving of >£1.6M to UK asparagus growers per year. There would also be an improved ability of UK growers to meet customer (supermarket) demand during the British asparagus season.

## Action Points

This is only the 3rd year of this long-term replicated field trial now continued under FV 450a. The results continue to support the recommendation that 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.