Grower Summary

FV 450

Asparagus: Sustainable soil management for stand longevity and yield optimization

Annual 2017

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AHDB Horticulture,
AHDB
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

AHDB Horticulture is a Division of the Agriculture and Horticulture Development Board.

Project title:	Asparagus: Sustainable soil management for stand longevity and yield optimization
Project number:	FV 450
Project leader:	Dr Rob Simmons, Cranfield University
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Key staff:	Dr Rob Simmons, Dr Sarah De Baets and Dr Joanna Niziolomski
Location of project:	Gatsford, Ross-on-Wye
Industry Representative:	Neil Cairns, Barfoots of Botley Ltd Sefter Farm, Pagham Road Bognor Regis, West Sussex PO21 3PX
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GROWER SUMMARY

Headline

Year one root profile distributions for asparagus varieties Gijnlim and Guelph Millennium can be used to identify and minimise risk of root damage associated with re-ridging and subsoiling operations. Success could have significant implications for stand longevity and productivity through decreasing susceptibility to crown and root rot.

Background

Field operations associated with UK asparagus production [tillage and spray operations, installation of plastic cloches, 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 (Drost & Wilcox-Lee, 2000; Putnam 1972; Reijmerink 1973; Wilcox-Lee & Drost 1991) and can decrease the susceptibility to crown and root rot caused by *Phytophthora megasperma* (Falloon & Grogan 1991) and *Fusarium oxysporum* f. sp. *asparagi* (Elmer, 2001). Both root damage and crown and root rots significantly contribute to yield decline.

In addition, compaction of wheelings leads to a significant reduction in infiltration resulting in an increased risk of surface water ponding and on sloping land, runoff generation and erosion. In turn surface water ponding and/or erosion compromises field operations impacting on both foot and vehicular traffic, whilst ponding in furrows increases the risk of crown and root rot leading to yield decline. The long-term field trials established under this project will critically evaluate 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. The experimental trials will compare shallow soil disturbance (SSD) and mulch attenuation options, cover/companion cropping, and non-till options against a conventional practice control.

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 cultivars Gijnlim and Guelph Millennium were planted on 20-21st of April 2016 on the flat at an anticipated depth of 0.14m with 0.16m spacing between the crowns on 1.83m wide bed centres.

Experiment 1 (48 experimental plots) is restricted to Gijnlim which represents 70% of UK field grown asparagus. Shallow soil disturbance (SSD) will be applied using a winged tine to

0.175m depth (Niziolomski et al., 2016). SSD is included in those treatments to which mulch (PAS 100 Compost or Straw) will be applied. The principal behind this is that the mulch-SSD treatments are intended to replicate the cover (mulch) and 'bio-drilling' (tillage-SSD) associated with the companion crops.

The companion crops to be included in the trials will be broadcast in July/August 2017 and are likely to be frost tolerant varieties of oil radish (or mustard), and rye. Final selection will be made at the Project Advisory Group (PAG) Meeting on 17th May 2017. Experiment 2, will elucidate varietal differences in root development/architecture and root profile distribution as affected by subsoiling treatments [as a mitigation measure to improve infiltration for the control of runoff and erosion] and annual re-ridging vs zero tillage. Experiment 2 is adjacent to Experiment 1 and is a cost effective way (16 additional experimental plots) of incorporating two experimental programmes within a single field trial.

Baseline soil sampling was undertaken during 17th – 21st October and 1st – 3rd November 2016. The results indicate that there is no significant difference is the parameters tested between experimental plots. This is critical as it means that any differences observed can in future, be attributed to the BMP treatments applied. It is of note that the high Penetrative Resistance (PR>3 MPa) measurements in the upper sub-soil could impact asparagus root development. Further, the observed high Bulk Density (BD) measurements (>1.45 cm^{-3}) in the mid top-soil and more notably in the upper sub-soil are likely to impede root growth (Jones, 1983). Historically, asparagus roots have been observed in soils with PR values of 1.96 MPa and 2.9 MPa). However, currently the limiting values of PR and BD for the unhindered expansion of asparagus storage roots are unknown. This project aims to address this knowledge gap, through the longer-term monitoring of this trial.

The baseline root coring results suggest that the current coring protocol will, as expected, form a robust basis to quantify the effect of the BMPs investigated on asparagus root architecture and varietal differences in root profile distribution.

Root mass density values are generally higher for Gijnlim as compared to Guelph Millennium for most soil depths and sample locations. However, after one-year of growth no significant differences were as yet detected. For both varieties, one year after planting circa 65% of the total measured plant root mass is found at the crown zero line, near the surface at 0.0 - 0.15 m depth. Very few roots have explored the soil at 0.3m, 0.6m and 0.9m away from the crown zero line. Further away from the crown zero line, roots tend to be mostly in the 0.15 – 0.30m and 0.3 - 0.45m soil layers and avoid the topsoil (0.0 - 0.15m). For both varieties, there were no roots detected (Root mass density (RD) values <0.1 kg m^{-3}) in any of the root cores (0.0 – 0.45m depth) taken 0.9m away from the crown zero line.

It is expected that the current long-term trials will form an evidence base for a paradigm shift in the way asparagus is cultivated in the UK particularly, the need for and intensity of, annual re-ridging operations. Minimizing root damage contributes to stand longevity and productivity and decreases the susceptibility to crown and root rot. When the dimensions of the re-ridged bed-form are superimposed on the baseline varietal root distribution, the results indicate that;

- For both Guelph Millennium and Gijnlim there is a risk of damaging 7-9% of total root biomass if the rotating tines of the bed-former used were to till soil to 0.15 -0.3m depth within 0.3m of the crown zero line.
- In addition, for Guelph Millennium there is a risk of damaging 2% of total plant root biomass if the rotating tines of the bed-former till soil to 0.0 - 0.15m depth within 0.3m of the crown zero line.

The year-one field trial results indicate that for both Gijnlim and Guelph Millennium varieties soiling operations - as a mitigation measure to improve infiltration for the control runoff and erosion - could be undertaken at operating depths of 0.175 – 0.3m, when crowns are planted on 1.83m centres. However, it is strongly advised that growers undertake exploratory root profile distribution surveys prior to commencing sub-soiling operations. Root coring protocols will be demonstrated and discussed at the Annual Asparagus Conference 2017 which will be held on Tuesday 18 July 2017. Results from year one of this long-term trial will also be presented.

Financial Benefits

It is envisaged that this project will provide information on the state of ‘asparagus soils’ and provide focused, practical and robust guidance on how to identify and alleviate compaction and water-logging in asparagus wheelings, thereby reducing the risk of asparagus decline, increasing asparagus yields and farm profitability, while minimising environmental impact (an important consideration for growers considering GAEC greening rules, the needs of assurance schemes, environmental audits and demonstrating sustainable soil management).

- Project outputs will provide a useful tool for dissemination, discussion and knowledge exchange with AGA members as well as the wider horticultural community that will help stimulate interest and develop awareness and industry expertise in sustainable soil management practices.
- During 2005 – 2015 the area under asparagus cultivation in the UK increased from 890 – 2235 ha (>250%). 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 2,396t, are valued at £8.4 million. Annual asparagus imports to the UK in 2014 amounted to 14,200t, 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* can result in up to 60% loss of stand amounting to up to £16 million in lost revenue per annum. A 10% reduction in yield losses due to asparagus decline would amount to a saving of >£1.6 million to UK asparagus growers per year.
- Improved ability of UK growers to meet customer (supermarket) demand during the British asparagus season.

Action Points

This is only the first year of this proposed long-term replicated field trial. As such it is not feasible to make robust action points. However, it is strongly recommended that growers undertake exploratory root profile distribution surveys prior to commencing re-ridging and/or sub-soiling operations. Root coring protocols will be demonstrated and discussed at the Annual Asparagus Conference 2017 held on Tuesday 18th July 2017.