

## Asparagus root growth patterns



Figure 1. Asparagus root architecture exposed

### Action points

- Storage roots do not regrow once damaged, so check where they are before undertaking tillage operations (ridging and/or subsoiling) by putting a spade into the ridge-wheeling zone to see how far roots are from the soil surface
- To get a picture of your root distribution across your field, root coring should be performed at circa 10 randomly selected locations on top of the ridge, on the side of the ridge and into the wheeling
- To get a more detailed view of your variety's root architecture, dig a soil pit and expose the crown and feeder roots (Figure 1)

### Background

Research over the past 20 years has shown that root damage associated with annual re-ridging has a major impact on asparagus plantation longevity and productivity (Drost & Wilcox-Lee, 2000; Putnam, 1972; Reijmerink, 1973; Wilcox-Lee & Drost, 1991). Such root damage increases susceptibility to crown and root rot infection and/or disease (caused by *Phytophthora asparagi* and *Fusarium* species), which contribute significantly to yield decline (Elmer, 2001, 2015; Falloon & Grogan, 1991). Furthermore, zero-tillage options have been shown to significantly increase (more than 100 per cent) the marketable yield of asparagus spears, as well as crown, fern and bud growth from year two onwards (Wilcox-Lee & Drost, 1991).

Much of the fieldwork in UK asparagus production (ie tillage operations such as ridging and subsoiling, spray operations, and harvesting) can result in progressive and

severe compaction of all inter-bed wheelings. This compaction can lead to significant reductions in infiltration, increasing the risks of surface water ponding, and on sloping land, run-off generation and erosion. In turn, such water ponding and/or erosion compromises field operations, impacting on both foot and vehicular traffic. Ponding in furrows also contributes to yield decline through the increased occurrence of crown and root rot.

Long-term asparagus field trials were established in April 2016 (AHDB Horticulture project FV 450) to develop and evaluate ‘Best Management Practices’ (BMPs) that could prevent and/or remediate wheeling compaction, improve soil structural status and reduce run-off and erosion in asparagus production systems. If successful, BMPs will halt or reduce asparagus yield decline, facilitate long-term sustainable and profitable production and ensure environmental protection.

It is known that the asparagus root system development depends on variety and environmental factors such as climate, landscape position, soil type, soil structure, nutrient status, interactions with the soil microbiology and

tillage operations. This technical update reports on root distribution in two varieties: Guelph Millennium and Gijnlim in the FV 450 two-year stand.

Project Findings

FV 450 measured and mapped the distribution of asparagus storage roots for Gijnlim and Guelph Millennium. An example root map (mean data from 16 plants) for Guelph Millennium after two years of crown growth is shown in Figure 2. Root mass densities (RMD) were plotted using a heat map system and according to soil depth and distance from the crown. Red indicates a region of very high root mass (closest to the crown), while blue shows very little or no roots. After one year of growth, most roots were found within the ridge zone and up to 0.4m deep within the soil profile. In the second year, average RMD (mean of six plants) increased from 8–12kg/m<sup>3</sup> in year one to ca. 20kg/m<sup>3</sup> (at the Crown Zero Line (CZL) and at ca. 0.2m deep). Two years after planting, the roots had grown vertically down to 0.6m deep into the profile and extended laterally 0.3–0.6m from the crown.

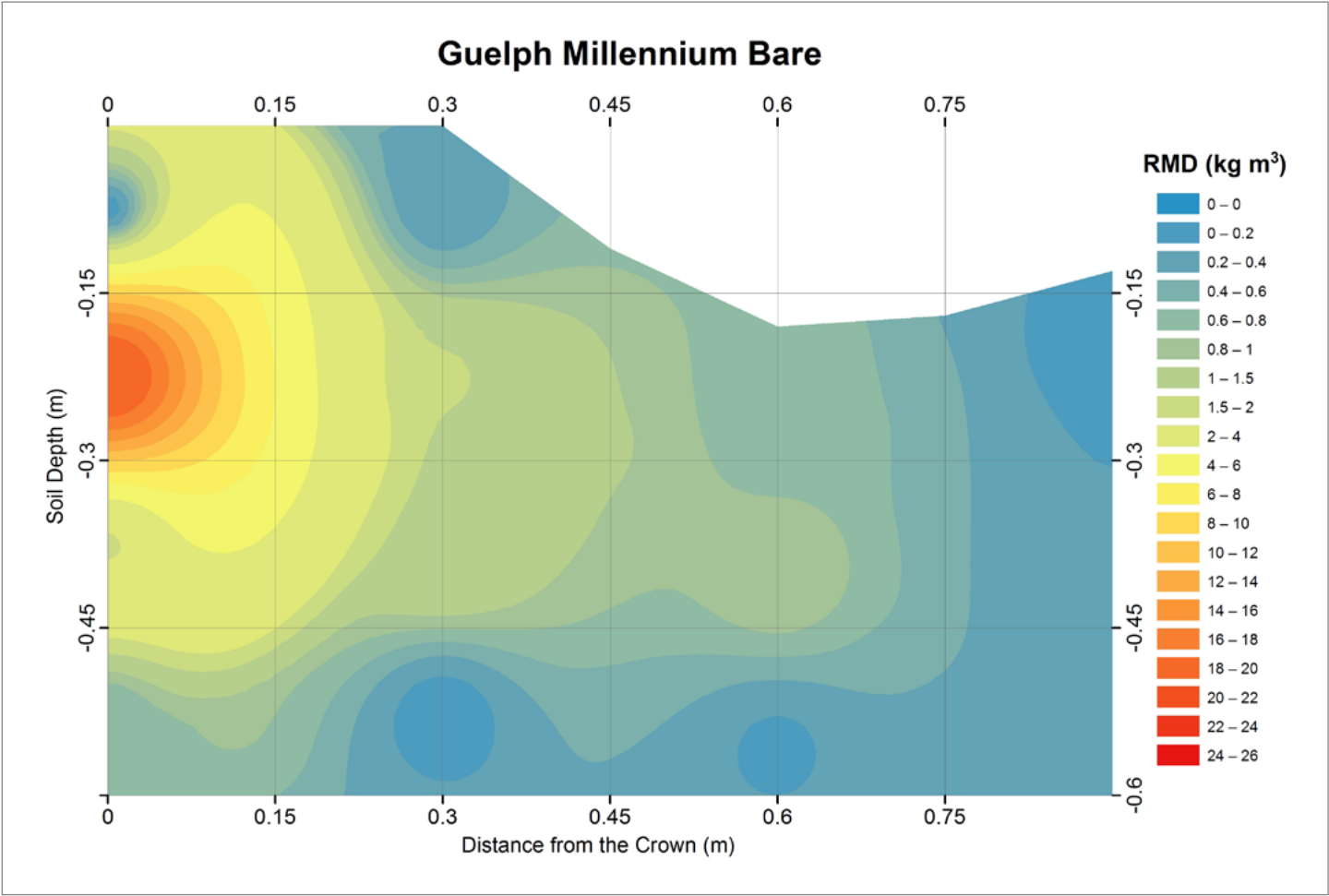


Figure 2. Example root map where root core data was used with GIS software to interpolate the root mass density (RMD, kg m<sup>-3</sup>) distribution from the ridge into the wheeling up to a depth of 0.6m (0.9m is the centre of the wheeling in this example). This map is from a FV 450 two-year-old Guelph Millennium stand



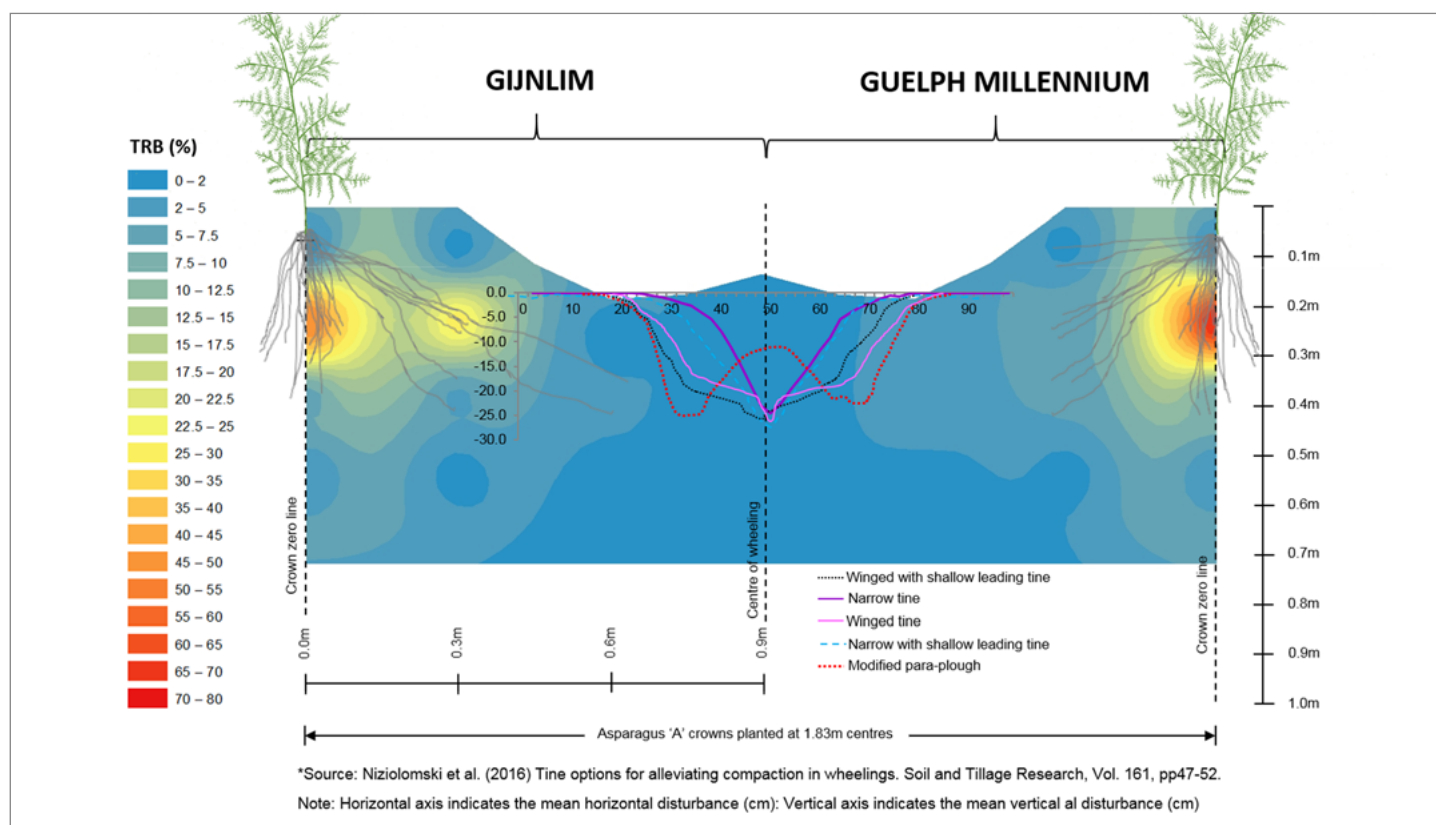


Figure 3. Potential root damage (in % of total plant root mass density, RMD) associated with below-ground soil disturbance profiles. A range of tines types and geometries operating at 0.3m working depth are illustrated by the dotted lines. Root maps are for a two-year-old stand

In addition to studying root distribution in the FV 450 newly established stand, a sampling study was undertaken which looked at root distributions of four-, six- and nine-year-old crops which were grown by the same business. Storage roots of a nine-year-old Guelph Millennium crop had grown more than 0.75m to 1.0m deep and had extended laterally into the wheeling. The majority of the nine-year-old crops' root mass occurred at the CZL 0.15–0.4m under the ridge, but up to 1kg of roots per cubic metre of soil could be found 0.5m from the crown and at a wheeling depth of 0.1–0.2m. This suggests that subsoiling deeper than 0.1m should be avoided and attention paid to the operating radius and tillage depth of the ridger. Other fields showed a substantial amount of roots in the wheeling, much closer to the surface, as shown in Figure 1, indicating a higher risk of damaging roots by tillage operations that are undertaken by growers to mitigate compaction in wheelings.

Figure 3 illustrates an FV 450 stand which was subsoiled at a depth of 0.3m. The results indicate neither the modified para-plough (red dotted line) or a winged tine (pink solid line) of dimensions/configuration investigated by Niziolowski et al. (2016) should be utilised, as the below-ground disturbance patterns intersect roots within the 0.15–0.30m depth, 0.6m from the CZL, suggesting damage to 2–5 per cent of total plant root biomass for both Gijnlim and Guelph Millennium.

This technical update will be published as a factsheet at the end of a follow-on project: AHDB Horticulture project FV 450a. FV 450a will further explore root profiles/distribution in a wider range of fields with varying varieties, stand age, wheeling centres, soil type and management practices.

For more detailed information on the project, see the final report, which is available on the AHDB website.



Asparagus crown consisting of rhizome, bud clusters, buds, fleshy storage roots and fine feeder roots

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## References

Drost, D. and Wilcox-Lee, D. (2000) Tillage alters root distribution in a mature asparagus planting. *Scientia Horticulturae*, 83(3–4), pp. 187–204.

Elmer, W.H. (2001) *Fusarium diseases of asparagus*. In: Summerell, B.A., Leslie, J.F., Backhouse, D., Bryden, W.L., Burgess, L.W., (editors), *Fusarium*, APS Press, pg. 248–262.

Elmer, W.H., (2015) Management of *Fusarium* crown and root rot in asparagus, *Crop Protection*, 73, pp. 2–6.

Falloon, P.G. and Grogan, R.G. (1991) Effect of root temperature, plant age, frequency and duration of flooding and inoculum placement and concentration on susceptibility of asparagus to *Phytophthora* rot. *New Zealand J Crop and Horticultural Science* 19: 305–312.

Niziolowski, J.C., Simmons, R.W., Rickson, R.J. and Hann, M.J. (2016) Tine options for alleviating compaction in wheelings. *Soil and Tillage Research*, 161, 47–52.

Putnam, A.R. (1972) Efficacy of zero-tillage cultural system for asparagus produced from seeds and crowns. *Journal of American Society for Horticultural Science* 97: 621–624.

Reijmerink, A. (1973) Microstructure, soil strength and root development of asparagus on loamy sands in the Netherlands, *Netherlands Journal of Agricultural Science*, 21, pp. 24–43.

Wilcox-Lee, D. and Drost, D. T. (1991) Tillage Reduces Yield and Crown, Fern, and Bud Growth in a Mature Asparagus Planting. *Journal of the American Society of Horticulture*, 116(6), pp. 937–941.

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