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This article is part of a series to promote better understanding of our agricultural soil resources along with practices that can influence soil health.

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Plant Roots and soil health

Rob Dunn, P.Ag. Cropping System Specialist, FarmWise Inc., Lethbridge, AB

Roots are the foundation for plant growth, representing about one third of the biomass for annuals and much more for perennial plants. They are the plants primary contact with soil, absorbing the moisture and nutrients necessary for growth while providing the carbon source for soil biological processes that help build soil quality. Most soil organic matter (SOM) is thought to originate from the by-products of microbial activity fueled by plant root exudates and the decomposition of root residues.

Over time we continue to gain a better understanding of the complex relationships between plant roots and microbial life that help facilitate nutrient uptake, protect plants from pathogens and build soil structure. The plant rhizosphere is that biologically active 1 to 2 cm zone surrounding roots with twice the density of soil microbes, supported mainly by photosynthetically derived carbon (purposely leaked from plant roots or decomposed from root material). This area has the greatest impact on soil structure.

Mycorrhizae fungi live in the rhizosphere of most plants with Brassica species like canola being one of the exceptions. Undisturbed hay, pasture or no-till situations favour mycorrhizae where they associate with roots to supply water and other nutrients in exchange for plant carbon. Their network of fungal hyphae helps the plant to explore a much greater soil volume at a "net savings" to the plant. We now know that mycorrhizae are so important from a soil quality perspective, secreting a stable glue-like substance called glomalin that helps with soil aggregate formation which in turn builds good soil structure. Productive soils will often have as much as one third of their SOM in the form of glomalin.[1]

Plant rooting action impacts soils directly by helping to aggregate soil particles, improving structure and resisting compaction from field traffic[2]. Decomposing roots feed soil biology that builds soil structure, soil organic matter and cycle nutrients to subsequent crops. Root channels remaining after decomposition – especially from tap roots, create macropores that improve aeration and water infiltration.

Diverse crop rotations or forage mixtures with good diversity are preferred since plants have different rooting patterns and unique relationships with soil microorganisms. Fibrous rooted crops like cereals have more roots per volume of soil and help produce stable aggregates. Tap rooted crops like canola can help build vertical structure with larger soil macropores following root decay.[3] Forage radishes have gained some notoriety of late, having a large aggressive taproot and touted as a biological remedy for compaction (see Figure 1). US research and demonstration has shown excellent results and Alberta trials have looked promising.[4]

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[1] Sticky Business – Glomalin provides the tie that binds. Building Better Soils, The Furrow. 2013. http://mycorrhizae.com/wp-content/uploads/2013/03/Glomulin-Provides-the-Ties-That-Bind-PDF.pdf

[2] The Biology of Soil Compaction. Ohio State University. 2009. http://ohioline.osu.edu/sag-fact/pdf/0010.pdf

[3] Agricultural Soil Compaction: Causes and Management. Agdex 510-1. Alberta Agriculture. 2010. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex13331/$file/510-1.pdf?OpenElement

[4] Tillage Radish Project. West-Central Forage Association. Entwistle, Alberta. 2012. http://www.westcentralforage.com/projects/tillage-radish%C2%AE.aspx

Figure 1. Tillage radish (photo courteousy of West-Central Forage Association)

In summary, plant roots are an important driver for soil health through the combination of direct physical action and indirectly through their carbon supply that fuels soil biology. Low soil disturbance systems with diverse crop rotations are preferred because of differences in physical rooting effects (fibrous versus tap rooted crops) and their relationships with soil microbial life that can impact soil quality. Perennial crops have a much more aggressive rooting action and more quickly build soil quality, especially when combined with well managed grazing.