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Black medic cover crop improves soil stability

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Generally, a black medic cover crop reduced the proportion of small aggregates and increased the proportion of large aggregates. Medic offers a natural way to maintain soil health in low external input cropping systems.

Black medic is a self-regenerating cover crop that grows under the crop canopy during the growing season and after harvest. It is an annual legume that reproduces from seed. Cover crops occupy niches within grain systems, providing soil protection from erosion, organic matter and nitrogen additions, and enrich the soil microbiome.

A previous Indian Head, Saskatchewan study found that under reduced nitrogen (N) fertilizer management (20% of the recommended rate), grain yields can be increased when self-regenerating black medic is included in the cropping system. However, questions remained about maintaining soil health under these reduced fertilizer regimes. To answer this question, research was conducted to find out whether black medic would improve soil aggregate stability under reduced N fertilizer inputs.

The research was part of a long-term study that was established in 2002 at the Agriculture and Agri-Food Canada research farm at Indian Head. A 3-year wheat-flax-oat rotation ran from 2002 until 2013, and it was changed to wheat–flax–canary seed in 2014. Nitrogen fertilizer rates were 20%,

60%, and 100% of required N based on results of soil tests (urea banded away from seed at time of seeding). Black medic was grown as a cover crop, and compared to plots without black medic. Medic was controlled with clopyralid herbicide in non-medic plots.

On May 18 and 19, 2017, soil samples for aggregate stability and bulk density were collected from blocks with and without medic, following the wheat and flax phases of the rotation, and at two of the N fertilizer rates ("low", or 20% of soil test recommended N; and "full", or 100% of soil test recommended N). Samples were taken from the 0 to 10 cm soil depth in the stubble row from the previous year's crop.

Soil stability improved with black medic under low N inputs

Mean weight diameter (MWD), a measure of the size distribution of water stable aggregates (WSA), was calculated. For wheat, there was a 21% increase in MWD of aggregates with medic in the low N treatment, but no increase in MWD with medic in the full N rate.

No significant medic or N rate effect was observed for MWD in the flax phase.

Aggregate size classes were also analyzed individually. The 1-2 mm size class contains the greatest proportion of microbial biomass carbon in soils, so increasing their proportion is important for soil health. In wheat, the medic cover crop increased the proportion of aggregates in the 1–2 mm size class under low N but not in the full N treatment.

In wheat, the only significant difference for the largest size class (2–6.3 mm) was between no medic/low N and both full N rate treatments. Therefore, medic once again increased aggregate stability under low N but not under full rate N.

In flax, no statistical differences were observed for aggregate size.

This is the first study to document the role of self-regenerating cover crops on aggregate stability. Medic consistently reduced the mass of small aggregates and increased the mass of large aggregates. In this way, medic improved the status of an important soil health indicator.

The effect of medic in increasing aggregate stability was similar, in many cases, to the effect of fertilizer N additions. Under reduced N cropping systems, medic plants were important to minimize the proportion of small aggregates and increase the proportion of large aggregates. Future cropping systems that aim to reduce N fertilizer inputs for environmental or economic reasons could consider cover crops, such as medic, to maintain soil health.

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Stainsby, A., May, W.E., Lafond, G.P., Entz, M.H. 2020. Soil aggregate stability increased with a self-regenerating legume cover crop in low-nitrogen, no-till agroecosystems of Saskatchewan, Canada. Can. J. Plant Sci.

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