

Oats as a catch crop for nitrogen management in the soil

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A catch crop is a crop planted after the main crop has been harvested with the objective of taking up the excess plant nutrients from applied fertilizer such as nitrogen (N). Removal of the excess N in the soil will lead to reduced leaching of nitrates or volatilization of ammonia. **Green manuring** is the working of the catch crop into the soil or killing it off (e.g. by rolling) and leaving it on the soil surface as a mulch. The associated benefits include reducing soil erosion and evaporation, lowering the soil temperature to create a more optimal environment for the microbial community, and supplying organic material for microbial decomposition which will release the nutrients gradually, as with a slow-release fertilizer. By taking up the excess nutrients, and releasing them slowly, leaching will be reduced. This is important as the effective uptake of applied N by the crop from nitrogenous fertilizers is less than 40%. Optimizing nitrogen use efficiency (NUE) is necessary to improve the economic feasibility of crop cultivation and reduce negative environmental impacts due to leaching and nitrous oxide emissions.

Several short-term studies have been conducted to evaluate the benefits of catch crops, particularly the reduced leaching of nitrates. A 28-year study was conducted in Denmark to evaluate the long-term benefits where it was observed that repeated planting of catch crops over several years significantly increased N uptake and NUE by the main crops. Thirty-five percent of the nitrogen retained was made available to the succeeding

crop, thereby reducing the N fertilizer application rate. Efficiency of catch crops in reducing N leaching persisted over the years at all the study sites (Berntsen *et al.* 2006).

All catch crops will take up nitrogen, but the type or mixture of crops that are planted will have different effects on the outcome. In organic farming, especially in stockless farming, where no flexible fertility inputs are available, this may contribute considerably to plant nutrition. Planting of a legume as part of the mix will benefit the soil by taking up excess nitrogen and biologically fixing N when nodules are formed. Although legumes exploit available N in the soil before intensifying biological N fixation, leguminous catch crops leave more soil inorganic N than non-leguminous catch crops. Legumes will also result in a rapid rate of decomposition due to a low C:N ratio, whereas grasses such as rye grass have a high C:N ratio so the decomposition rate is slower. Due to the high temperatures experienced in South Africa, a slower rate of decomposition would be preferable to reap the benefits of the mulch obtained from the catch crop. Furthermore, due to the climate, medium- to long-season crops (120 to 180 days) can be grown. With the slow decomposition of the catch crop, the release of the nutrients would then be spread over the growing season.

WISH-ROOTS project

An international research project titled "Tuning the wheat root microbiome to improve soil health and optimize rhizosphere



Oats catch crop planted in May 2022 on the prospective trial site at the ARC research farm near Brits in Northwest Province

nitrogen cycling and availability (WISH-ROOTS) is currently ongoing, with the objective to monitor various wheat landrace varieties (bread and durum) and traits including root structure and the amount of nitrogen required for growth. The consortium includes partners from the UK, Italy, South Africa, China, Germany, Belgium and Spain. Overall, the project aims to provide resources to develop advantageous cultivars for farmers that support a more sustainable use of land, by reintroducing the positive traits of the landraces, such as beneficial root architectural traits, thereby improving soil microbial biodiversity and structure, as well as nutrient cycling.

The Agricultural Research Council (ARC) is leading the South African component of the WISH-ROOTS project. To conduct a wheat field trial, land with a low residual nitrogen level was required as a starting point. Therefore oats – a winter crop with allelopathic effects on the summer weeds – was selected as a catch crop to aid in residual N depletion from the soil.

The oats catch crop sufficiently reduced the N content in the soil to a level that was suitable for the subsequent wheat trial. Whilst the intention of planting oats in the project was merely to reduce residual N levels in the soil, an inadvertent outcome was to demonstrate the potential of oats as a promising catch crop.

Reference

Berntsen J, Olesen JE, Petersen BM, Hansen EM. 2006. Long-term fate of nitrogen uptake in catch crops. *Europ. J. Agronomy* 25: 383-390

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For more information:

Visit the WISH-ROOTS website: <https://www.wishroots-ejpsol.net/> and social media page: https://twitter.com/wish_roots

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