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Leibniz Center for Agricultural Landscape Research (ZALF)

New plant mixture convinces in practical test:

Ribwort plantain increases forage yield and protects groundwater

A new study conducted in collaboration with the Leibniz Centre for Agricultural Landscape Research (ZALF) shows When farmers combine alfalfa with ribwort plantain, the forage yield can be doubled compared to conventional mixtures. At the same time, less nitrate enters the groundwater. The results were published in the international Agronomy Journal.

The researchers investigated how different plant mixtures affect yields and nitrogen distribution in the soil under dry conditions in organic farming. Mixtures of alfalfa and ribwort plantain were particularly successful. This combination not only led to a significant increase in yields, but also measurably reduced the amount of nitrate in the soil at depths from which nitrate can easily leach into the groundwater.

What are nitrate losses - and why are they a problem?

Nitrate is a form of nitrogen that plants need to grow. However, when plants are rotated in the fall - such as alfalfa - the succeeding crop cannot absorb enough nitrogen from the soil to prevent nitrate leaching. Rainfall can wash this nitrate out of the soil into deeper layers, where it is no longer available to the plants.

These so-called nitrate losses are not only an economic disadvantage for agriculture, but also an environmental problem: if too much nitrate gets into the groundwater, this can endanger the quality of drinking water. It is therefore particularly important to avoid such losses in ecologically sensitive areas, such as water protection areas.

Twice as much feed - significantly less nitrate in the soil

The field trials took place in the organically managed Canitz water protection area near Leipzig. Alfalfa in a mixture with ribwort plantain provided twice as much forage mass compared to traditional alfalfa-grass mixtures, such as with meadow fescue.

"Especially in the fall, when the plants absorb less nitrogen, the risk of nitrate leaching increases. Our results show that ribwort plantain not only increases the amount of feed, but also actively contributes to the protection of groundwater," says Tsvetelina Krachunova, head of the study and scientist at ZALF.

Ribwort plantain contains natural substances that slow down the conversion of ammonium to nitrate in the soil. This means that more nitrogen is retained in a form that plants can use, but which is not so easily washed out. This is particularly important in times when there is a lot of rain and little plant growth.

New knowledge for climate-adapted agriculture

The researchers recommend sowing ribwort plantain selectively and in appropriate quantities to avoid overgrowth of alfalfa. A sowing rate of around one hundred germinable seeds per square meter proved to be optimal. The results are particularly relevant for regions with water shortages or for use in water protection areas.

The study provides new insights for the further development of ecological cultivation systems under the conditions of climate change. With the combination of higher yield and lower environmental impact potential, it offers a practical approach for farmers.

Project partners:

- Dresden University of Applied Sciences, Chair of Organic Farming
- Wassergut Canitz GmbH
- Leibniz Centre for Agricultural Landscape Research ZALF

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This is a summary of the original text created with the help of artificial intelligence: Krachunova, Tsvetelina; Bellingrath-Kimura, Sonoko; Schmidtke, Knut (2025): Annual ribwort plantain and alfalfa mixtures enhance forage accumulation and reduce nitrate. In: Agronomy Journal. Volume 117, Issue 3, Article number e70098; published under the Creative Commons Attribution 4.0 International (CC BY 4.0) license: https://creativecommons.org/licenses/by/4.0/
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The text has been carefully reviewed and revised under the aspects of AI regulations at ZALF.

50% alfalfa in a mixture with 50% ribwort plantain with 200 germinable grains/m² each for the 3rd cut. Source: © Tsvetelina Krachunova / ZALF | Image source in color and print quality: http://www.zalf.de/de/aktuelles

Ribwort plantain in pure seed with 400 germinable seeds/m² for the 3rd cut in September. Source: Tsvetelina Krachunova / ZALF | Image source in color and print quality: http://www.zalf.de/de/aktuelles

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About the Leibniz Centre for Agricultural Landscape Research (ZALF) in Muencheberg, member of the Leibniz Association:

Mission of ZALF is to deliver solutions for an economically, environmentally and socially sustainable agriculture –together with society.

As a contribution to overcoming global challenges such as climate change, food security, biodiversity conservation and resource scarcity, we develop and design crop systems, integrated in their landscape contexts that combine food security with sustainability. Therefore we process complex landscape data with a unique set

of experimental methods, new technologies and models as well as socio-economic approaches.

ZALF research is integrated systems research: starting from processes in soils and plants to causal relationships on the field and landscape level up to global impacts and complex interactions between landscapes, society and economy. www.zalf.de