



Boosting lettuce stress resilience

Exploiting *Lactuca serriola* genetic diversity for more resilient and sustainable crops



Introduction

Wild relatives such as Lactuca serriola carry a wealth of untapped genetic diversity that helps them thrive under stress, while cultivated lettuce often struggles when nutrients are limited, especially under low phosphate conditions, leading to reduced yields. Exploring lettuce CWRs can reveal useful traits and genetic regions that breeders can use to develop stronger, more resilient lettuce varieties.

Objectives

The COUSIN project explores how wild lettuce (*Lactuca serriola*) copes with stress, focusing on low phosphate availability. Phosphorus is essential for plant growth, yet phosphate fertilisers are costly, environmentally harmful, and based on finite resources. Lettuce is the most important of the leafy vegetable crops, which in total cover 18.1% of the fresh vegetable production area in Europe.

By screening diverse wild lettuce populations, the project identifies both visible traits (like leaf growth, photosynthesis, and nutrient content) and their underlying genetic markers. High-throughput phenotyping and genome-wide analysis connect plant performance under stress to specific genes. These insights give breeders practical tools to introduce resilience traits into cultivated lettuce, helping farmers reduce fertiliser use while maintaining yield and quality.





Results

Around 150 wild lettuce accessions were tested under both normal and low phosphate conditions using hydroponics and advanced imaging technologies. Clear differences emerged: some plants maintained better leaf growth, chlorophyll function, and nutrient balance under stress. A genome-wide association study (GWAS) highlighted a key region on chromosome 6 linked to improved photosynthetic efficiency (Φ PSII) in low phosphate conditions. Representative accessions from different regions were selected for whole-genome sequencing. These findings confirm that wild lettuce carries valuable traits for phosphorus use efficiency, traits that can be transferred to cultivated lettuce.

Recommendations

New lettuce varieties developed from *Lactuca serriola* lines with higher phosphorus efficiency could transform farming. For growers, this means lower fertiliser costs, more stable yields in low-input systems, and a reduced environmental footprint. For breeding companies, the identified genetic markers offer a shortcut to selecting superior lines and tailoring them for different regions or production systems. Tapping into wild lettuce diversity not only could improve sustainability but also could strengthen crop resilience in the face of nutrient stress and global fertiliser challenges.

