

# STRONGER HEMP, HEALTHIER SOILS

## HOW TILLAGE AND LEGUME ROTATIONS IMPACT ORGANIC HEMP–BARLEY SYSTEMS

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### OVERVIEW

**Industrial hemp is gaining interest for fiber and grain, but growers face challenges with crop establishment, nitrogen supply, and soil health. Hemp is often grown with legumes and barley in rotation, yet limited research has examined how these practices work together in organic systems.**

Organic hemp can be difficult to establish, especially under no-till where residue and early weeds reduce stands. Frequent tillage, however, can weaken soil over time.

In legume–hemp–barley rotations, legumes supply nitrogen, hemp suppresses weeds and builds deep roots, and barley uses leftover nutrients. Farmers need clear guidance on how tillage, cover crops, and nitrogen rates affect both hemp and the following barley crop.

This study compared conventional till and no-till, with and without legume cover crops, across organic nitrogen rates to measure yield, nitrogen use, and soil health.

### HIGHLIGHTS



Tillage was critical for successful hemp establishment and yield.



Cover crops improved hemp and barley yields under conventional tillage.



Moderate nitrogen rates increased hemp and barley yield without added benefits at higher rates.



No-till improved soil health indicators.

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We conducted multi-year field trials (2021-2024) comparing conventional till and no-till systems, with and without legume cover crops, and four nitrogen rates (0, 45, 90, and 135 lb N ac<sup>-1</sup>). Hemp biomass and grain yield were measured at harvest. Barley was planted after hemp, and its biomass, grain yield, protein level, and germination were measured to evaluate rotational effects and grain quality. The major observations include:

### 1. Tillage improved crop establishment and yield

Conventional tillage produced stronger hemp stands and higher yields. Fiber hemp biomass reached up to 4.3 t ac<sup>-1</sup>, and grain yields up to 1.2 t ac<sup>-1</sup> under tilled systems. No-till with heavy residue often reduced stands and yield, even though some soil health indicators improved.

### 2. Cover crops and moderate nitrogen improved system performance and soil health

Legume cover crops supplied 105 - 301 lb N ac<sup>-1</sup>, increased hemp growth, and boosted barley yields up to 3.4 t ac<sup>-1</sup> without reducing grain quality. No-till with cover crops helped maintain soil organic matter, improve active carbon, and support better soil structure, strengthening long-term soil health in the rotation.

Overall, combining cover crops with strategic tillage and moderate nitrogen balanced strong yields with regenerative benefits, improving soil health, system resilience, and environmental performance in diversified organic hemp–barley rotations.



Cover Crop



Hemp



Barley



## KEY TAKEAWAY

**In organic hemp–barley rotations, tillage is often needed for strong hemp stands and reliable yield, while cover crops and moderate nitrogen support productivity and soil health. No-till improved some soil measures but did not produce dependable hemp yields under these conditions.**



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