

GROWING STRONGER HEMP FIBER WITH REGENERATIVE PRACTICES

HOW TILLAGE, COVER CROPS, AND NITROGEN MANAGEMENT AFFECT HEMP FIBER QUALITY

Dinesh Panday, Parinaz Heydar, Casey Lapham, Alyssa Pierce, Madhav Dhakal, Arash Ghalegholabbehbahani, Gabriella Fioravanti, Ronald Kander



OVERVIEW

Industrial hemp is becoming popular for textiles and building materials. Fiber quality, how strong and flexible, is just as important as yield. Farmers want to know how tillage, cover crops, and nitrogen use affect both production and fiber strength.

Many farmers use nitrogen fertilizer to boost hemp growth, but too much nitrogen can lower fiber strength. Reduced tillage and cover crops may improve soil health, yet their impact on fiber quality is still unclear. Farmers need simple guidance to balance yield, fiber strength, and input costs.

This study tested how tillage (till vs. no-till), cover crops (with or without), and four nitrogen rates (0, 45, 90, and 135 lb ac⁻¹) affected hemp fiber yield and strength (i.e., maximum load, modulus of elasticity, tenacity, and work of rupture) in regenerative organic systems in Pennsylvania.

HIGHLIGHTS



High nitrogen increased biomass but reduced fiber strength by 40–70%.



No-till with cover crops produced the strongest fibers (about 600 MPa).



Moderate inputs (≈ 45 lb N ac⁻¹) balanced yield and quality, giving 2–3 times more biomass with only small losses in fiber strength.

READ THE FULL ARTICLE HERE:



We conducted field trials comparing tillage systems, cover crops, and four nitrogen rates. Hemp yield was measured, plants were field retted before fiber separation, and fiber strength was tested using a tensile machine (AADMET MicroTester) to evaluate how tough and flexible the fibers were (Fig. 1). The major observations include:

1. Regenerative Practices Improved Fiber Quality

Hemp grown under no-till with cover crops and little or no added nitrogen produced the strongest and most flexible fibers. Under this system, tenacity reached 610.5 MPa (Fig. 2), work of rupture 31.4 newton mm⁻², and maximum load 23.8 newton. These fibers are well suited for high-value textile uses.

2. High Nitrogen Increased Yield but Weakened Fibers

Higher nitrogen rates increased plant growth and biomass, especially in tilled systems. However, fiber strength and durability declined as nitrogen increased, showing a clear trade-off between yield and quality.

3. Moderate Nitrogen Balanced Yield and Quality

Moderate nitrogen rates supported good biomass production while maintaining acceptable fiber strength, making them suitable for most industrial applications.

FIGURE 1.

Stress–strain curve of hemp fiber showing maximum load, modulus of elasticity, tenacity, and work of rupture for assessing fiber quality and application suitability.

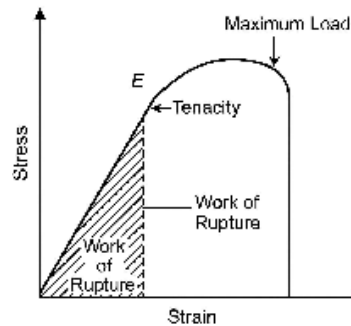
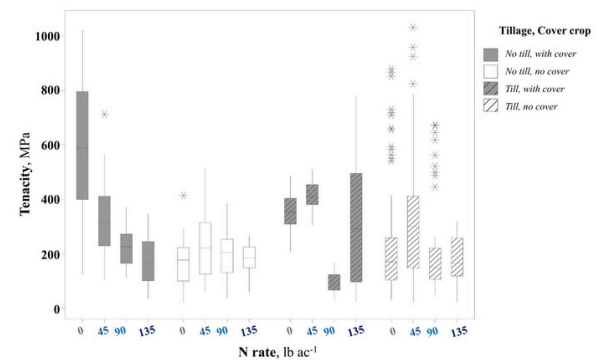


FIGURE 2.

Boxplot of hemp fiber tenacity as affected by tillage, cover crop, and N rates.





KEY TAKEAWAY



Hemp fiber quality depends on management. For strong, high-value textile fiber, use no-till with cover crops and low nitrogen. For higher biomass, moderate nitrogen with cover crops offers balance. Regenerative practices improve fiber strength and protect soil health.

Acknowledgment: This material is based upon work supported by the U.S. Department of Agriculture, under agreement number [NR212D37XXXXG001]. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Department of Agriculture.