Science Societies

Industrial hemp innovation in the U.S. Northeast

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Dinesh Panday, soil scientist with the Rodale Institute, with fiber hemp.

Industrial hemp is making a comeback in the U.S. Northeast, aided by research on its potential for fiber, grain, and CBD production under organic and regenerative farming systems. Recent field trials highlight promising hemp varieties, optimal nutrient management, and spacing strategies that boost yields while improving soil health and environmental sustainability.

Industrial hemp (*Cannabis sativa* L.) has re-emerged as a promising crop in the United States, driven by its diverse industrial applications, environmental benefits, and compatibility with organic and regenerative farming systems. Once widely grown across Pennsylvania before its prohibition in the 1940s, hemp production resumed following the passage of Pennsylvania's Industrial Hemp Research Act in 2016. Since then, the Rodale Institute has taken a leading role in revitalizing hemp cultivation in the region with scientific research focused on fiber, cannabidiol (CBD), and grain hemp that benefits farmers, the environment, and rural economies.

With field stations in Kutztown and the Pocono Organic Center in Blakeslee, Rodale is conducting trials that address the region's unique soils, climate, and organic farming systems. These short- to mid-term trials investigate the impact of variety, fertility management, and spacing on yield, quality, and ecological performance of industrial hemp, providing timely, science-based guidance to farmers.

Fiber hemp varietal trial field at mid-season.

Agronomic metrics

The central focus of Rodale's work has been evaluating industrial hemp varieties under regenerative organic practices. Recent research, published in *Agrosystems, Geosciences & Environment*, demonstrates some key discoveries:

In a two-year field trial (2022–2023), four varieties (MS 77, Futura 75, Santhica 27, and Han NE) were studied for biomass, bast fiber, hurd yield, seed weight, and root mycorrhizal colonization. Results published in *Agrosystems, Geosciences & Environment* showed that Han NE and MS 77 produced the higher biomass (Han NE: 5.2 Mg ha and MS 77: 4.6 Mg ha) and stem yield compared to Futura 75 and Santhica 27. All varieties exhibited beneficial fungal colonization in roots, with MS 77 having the highest level, indicating strong potential for nutrient uptake and stress resilience. Based on these findings, Han NE and MS 77 are promising fiber hemp options for U.S. Northeast growers. These results help farmers align cultivar selection with end-use goals and local conditions.

Fiber hemp at 19-cm spacing in the research field.

Beyond variety selection, optimizing nitrogen (N) inputs has been a major focus of the research, especially under organic systems where synthetic fertilizers are not permitted. In CBD hemp trials using Kirsche and Lindorea varieties, medium organic N rates (~100 kg N ha) were shown to maximize both biomass and cannabinoid yield while maintaining environmental sustainability. Higher N inputs did not translate to better results and even led to reductions in total CBD concentration. These findings underscore the need for precision nutrient management in hemp to avoid waste and environmental harm while maximizing economic returns.

Researchers also investigated how row spacing and fertility levels influence yield and fiber characteristics in fiber hemp. In these trials, narrower spacing (19 cm vs. 38 cm) produced higher plant populations and biomass yields, but wider spacing encouraged thicker stalks and greater bast fiber output per plant. This trade-off gives farmers flexibility depending on their production priorities. The highest bast fiber yield was achieved at moderate N levels and a 19-cm row spacing, underscoring the need to balance plant density and nutrient supply to meet production goals.

Mechanical properties, environmental benefits, and education

In addition to agronomic metrics, Rodale is also testing mechanical properties of hemp fiber, such as tensile strength, to assess its suitability for textile and industrial markets.

> Early data suggest that regenerative organic production practices not only support yield and environmental outcomes, but may also contribute to high quality fiber properties.

The environmental benefits of hemp in regenerative systems are significant. With its deep roots and rapid canopy closure, hemp suppresses weeds, improves soil structure, and supports carbon sequestration. Rodale's trials have documented positive outcomes for soil organic matter, microbial activity, and mycorrhizal colonization—all indicators of long-term soil health. These results support hemp's role in advancing both climate resilience and soil restoration on organic farms.

In order to help translate research into action Rodale is investing in farmer engagement and education by producing one-page research briefs and online tools and hosting field days and workshops. These resources aim to empower farmers to make informed, site-specific decisions and adopt hemp as part of a resilient, diversified farm system.

As demand for sustainable materials and plant-based products grows, industrial hemp offers a viable solution. Through science-driven innovation rooted in regenerative principles, Rodale is helping shape a new era of hemp production in the U.S. Northeast; one that aligns ecological stewardship with economic opportunity.

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structure, and supports carbon sequestration.

Dig Deeper

Read the recent *Agrosystems, Geosciences & Environment* papers cited in this article:

Panday, D., Acharya, B. S., Dhakal, M., Caton, T., Lapham, C., Smith, A., & Ghalehgolabbehbahani, A. (2025). Industrial hemp yield and chemical composition as influenced by row spacing, fertilization, and environmental conditions. *Agrosystems, Geosciences & Environment, 8*, e70093. https://doi.org/10.1002/agg2.70093

Panday, D., Heller, W. P., Carrara, J. E., Bhusal, N., Omoding, N., Caton, T., Walsh, A., Smith, A., & Ghalehgolabbehbahani, A. (2025). Performance and mycorrhizal colonization of industrial hemp varieties under regenerative organic systems in Northeastern region. *Agrosystems, Geosciences & Environment, 8*, e70091. https://doi.org/10.1002/agg2.70091

Panday, D., Acharya, B. S., Bhusal, N., Afshar, R. K., Smith, A., & Ghalehgolabbehbahani, A. (2025). Precision nitrogen management for optimal yield and cannabinoid profile in CBD hemp agronomy. *Agrosystems, Geosciences & Environment, 8*, e70028. https://doi.org/10.1002/agg2.70028

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