

Research Summary 2025-26

Regenerative Organic Agriculture Research in India

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The first year of research shows promising results for diversified regenerative organic farming, including strong crop performance, greater biomass production, and improvements in soil health indicators. Economic results varied by trial and measure, reinforcing the need for long-term assessment.

A collaborative research initiative

Established in 2025, the initiative brings together the University of Agricultural Sciences, Dharwad (UASD), Gallant International Inc., its India-based affiliate GROPL, and Rodale Institute. Research is housed at UASD's Institute of Organic Farming and builds on the university's long-term farming systems research, begun in 2004.

The program focuses on cotton alongside food and oil crops that may expand nutrition and income opportunities for smallholder farmers. Three field trials examine farming systems, biointensive management, and ecological pest control. A complementary breeding program develops non-GMO cotton varieties for organic production.

What the first year tells us

The regenerative organic system achieved the highest cotton equivalent yield in the comparative trial and the highest reported gross and net returns under the report's premium assumption. Chemical farming had the highest benefit-to-cost ratio. Regenerative organic plots also showed favorable soil nutrient and microbial activity indicators.

These are initial results from trials established in 2025-26. Delayed establishment affected cotton and pigeonpea performance, and nutritional analyses remain ongoing. Sustained productivity, carbon accumulation, costs, and climate resilience require further study.



Monitoring team visit to field trials at UASD on 30 August 2025.



Crop Performance and Farm Economics

Comparing four farming systems

The long-term trial compares regenerative organic, organic, integrated nutrient and pest management, and chemical farming across four cropping systems. These range from cotton monocropping to diversified two-year and four-year rotations. Crops include cotton, pigeonpea, groundnut, sorghum, corn, brown-top millet, linseed, and greengram, with sunnhemp and lucerne cover crops.

To compare diversified systems, individual crop yields were converted to cotton equivalent yield. This measure represents combined crop performance; it is not the direct harvested cotton yield.

Farming system	Cotton equivalent yield (kg/ha)	Benefit-to-cost ratio
Regenerative organic (FS I)	2,602.0	2.38
Organic (FS II)	2,378.8	2.09
Integrated management (FS III)	2,467.4	2.31
Chemical farming (FS IV)	2,354.3	3.20

The regenerative organic yield was significantly higher than organic and chemical farming and statistically on par with integrated management. The intensive two-year rotation with four crop cycles (CS3), beginning with groundnut followed by sorghum and linseed, achieved the highest cotton equivalent yield among cropping systems: 3,226.3 kg/ha.

Returns and economic tradeoffs

Using a 10% premium for organic produce, the report recorded regenerative organic gross returns of US\$2,378.61 (₹197,425) and net returns of US\$1,378.31 (₹114,400). Reported net returns were 25.00% above organic farming, 15.19% above integrated management, and 0.58% above chemical farming.

Chemical farming nevertheless achieved the highest benefit-to-cost ratio, at 3.20. Higher net returns and a higher benefit-to-cost ratio describe different aspects of profitability and should be assessed together.

Across cropping systems, CS3 recorded the highest gross income, US\$2,811.39, and net returns, US\$1,631.02. The initial results support further investigation of diversified rotations while avoiding conclusions about long-term economic performance.



Diversified field plots at the Main Agricultural Research Station, UASD.



Soil Health and Biointensive Practices

Biomass and soil organic carbon

Regenerative organic and organic systems produced more fresh and dry biomass than integrated and chemical systems. Biomass recycling, cover crops, and surface mulch are central practices being studied for their contribution to soil function.

Farming system	Fresh biomass (t/ha)	Dry biomass (t/ha)	Higher SOC accrual vs chemical
Regenerative organic	24.08	6.78	12.2%
Organic	21.90	7.08	24.0%
Integrated management	15.90	4.95	15.0%
Chemical farming	14.78	4.30	Reference

SOC means soil organic carbon. Percentages describe the higher accrual reported relative to chemical farming; they are not absolute soil carbon concentrations.

Regenerative organic and organic plots recorded significantly higher available nitrogen, phosphorus, iron, manganese, and copper than integrated or chemical systems. Dehydrogenase and phosphatase enzyme activity was highest under regenerative organic management, followed by organic, integrated, and chemical systems. These measures indicate early differences in soil biological activity.

The CS3 rotation also led biomass production, with 32.10 t/ha of fresh biomass and 8.83 t/ha of dry biomass. Continued monitoring is needed to establish whether these early differences persist.

Biointensive management in cotton and pigeonpea

A second trial evaluates eight practices combining broad bed furrows, crop-residue mulch, rotation, cover crops, legume intercropping, and seaweed-extract foliar spray. The best-performing combination achieved a cotton equivalent yield of 1,204 kg/ha, compared with 1,072 kg/ha for broad bed furrows with chemical inputs.

Pigeonpea averaged 1,154 kg/ha in cotton equivalent yield, compared with 1,075 kg/ha for cotton. Delayed sowing affected cotton performance. Diversified treatments narrowed the profitability gap, although the chemical control retained the highest net returns.

Broad bed furrows improved drainage and reduced waterlogging-related disease in pigeonpea. Legume intercropping and seaweed extract offered ecological alternatives for managing cotton leaf spot, especially early in the season.



Ecological Pest Management and Next Steps

Pest management in non-Bt cotton

The third field trial compares regenerative organic, organic, integrated pest management (IPM), and chemical modules. Practices include sunnhemp intercropping, bhendi and marigold trap crops, maize barriers, sticky traps, and pheromone traps. Researchers track insect pests, natural enemies, disease, yield, and economics.

IPM recorded the highest cotton yield, 1,205.6 kg/ha, statistically on par with chemical management at 1,121.9 kg/ha and regenerative organic management at 1,109.8 kg/ha. Organic management recorded 1,097.4 kg/ha.

Chemical management provided the strongest immediate pest suppression, including up to 72.6% lower leafhopper populations relative to the control, and chemical and IPM modules achieved the highest net returns. Regenerative organic management sustained the richest natural-enemy community, supporting further research into ecological pest regulation. Rust and leaf spot incidence varied with crop stage and management.

Developing non-GMO cotton varieties

The breeding program uses traditional non-GMO genetics to develop cotton suited to organic production and high-quality textiles. Selection targets include drought and heat tolerance, tolerance to insect damage, fiber quality, and biological markers to help distinguish varieties and reduce fraud risks.

Breeding activities at UASD and in southern India allow two seasons of crossing, evaluation, and selection. The program aims to create open-source lines for local and regional selection, with potential income opportunities for communities, including women involved in seed cleaning and sales.

Priorities for continued research and collaboration

Next steps include maintaining the long-term trials, completing nutritional and biochemical analyses, and strengthening coordination and knowledge sharing across university, institute, industry, and farmer partners. Continued funding is sought for research, farmer education, and adoption of regenerative practices.

The trials are intended to inform farmer training in the region. Multi-year evidence will be essential to understand sustained changes in soil health, input costs, productivity, and resilience.



Rodale-Gallant-UASD team with university administration.

Source: Gallant-UASD Regenerative Organic Agriculture Research Centre, Summary of Research Results: Annual Report 2025-26, revised report.

