

Moringa (*Moringa oleifera*)–Vegetable Agrisilviculture Under Fertilizer Inputs: Evidence Synthesis of Productivity Outcomes, Soil Fertility Trajectories, and Tree–Crop–Soil Mechanisms

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Rationale

Agrisilviculture can couple high-value vegetables with multifunctional trees to improve soil quality and resource efficiency in tropical and subtropical farms.

- Moringa adds biomass, moderates microclimate, and can support soil nitrogen through symbioses.
- Fertilizer needs may differ from monoculture because tree–crop interactions change nutrient cycling and light availability.

Aim of this evidence synthesis

To compile and interpret published findings on how Moringa–vegetable intercropping performs under fertilizer inputs, emphasizing yield responses, soil fertility trends, and plausible mechanisms.

- Summarize vegetable productivity outcomes across environments and study designs.
- Map soil chemical and biological trajectories linked to litter and root effects.
- Highlight risks (competition, allelopathy) and define research priorities for nutrient recommendations.

Evidence-synthesis workflow

Define scope

- 1 Moringa–vegetable systems with fertilizer context

Search & screen

- 2 Databases + keywords; field and pot studies

Extract outcomes

- 3 Yield, soil N–P–K, organic matter, biotic indicators

Synthesize patterns

- 4 Direction, magnitude, heterogeneity drivers

Identify gaps

- 5 Standard nutrient protocols and mechanistic tests

Key findings from the literature

Reported trials indicate that Moringa integration modifies light interception, nutrient cycling, and organic inputs, producing crop-specific responses rather than uniform benefits.

- Shade reduces incident radiation; outcomes depend on vegetable light needs and phenology.
- Soil nitrogen often increases near Moringa rhizospheres in studies reporting stronger biological activity.
- Canopy litter commonly raises soil organic matter and improves structure and water retention.
- Some studies report suppression linked to leaf-derived phenolics and saponins; intensity varies with decomposition and moisture.

Tree-crop-soil mechanism map

Moringa canopy

- Microclimate moderation (shade, temperature, wind)
- Litter production and nutrient return

Fertilizer inputs

Interact with tree-driven cycling

Litter decomposition

- Organic matter buildup, aggregation, water holding
- Potential allelochemicals (phenolics, saponins)

Root-rhizosphere effects

- Enhanced microbial activity and nutrient mineralization
- Local soil nitrogen enrichment reported in multiple studies

Vegetable performance

- Yield response is crop- and context-dependent
- Balance between facilitation and competition

Evidence gaps and research priorities

The evidence base is informative but inconsistent, with wide variation in fertilizer regimes, vegetable species, canopy management, and baseline soils.

- Standardize nutrient recommendation approaches (rates, timing, placement) for tree-vegetable systems.
- Quantify light–yield responses under spacing and pruning scenarios across seasons.
- Test allelopathy with controlled decomposition and moisture, linking chemistry to bioassays.
- Track long-term soil indicators (organic carbon, nitrogen dynamics, microbial functions) to verify sustainability.

Practical takeaway

Moringa–vegetable agrisilviculture can strengthen soil fertility processes, yet yield benefits under fertilizers depend on canopy control, crop selection, and site-specific conditions. Tailored nutrient strategies are needed instead of monoculture-based extrapolation.