

Higher density improved plant architecture and the percentage of marketable fruit for mechanical harvest in New Mexico green chile, whereas a moderate density of 37,037 plants ha⁻¹ in chili pepper improved yield while also providing moderate weed suppression.

For sustainable pepper production, the main implication is that optimized density can increase land productivity without proportionally increasing resource use, but only when density remains within the crop's tolerance range. Under precision fertigation, higher chili densities up to 106,666 plants ha⁻¹ increased total yield and had positive effects on water, nitrogen, and phosphorus use efficiency, while in rainfed maize moderate density rather than excessive density improved yield stability and resource-use efficiency, offering a useful principle for pepper systems. Sustainability also depends on matching density to microclimate management and climate stress adaptation. Moderate shading improved pepper productivity in some environments, but increasing shade intensity to 60% could reduce fruit yield or fruit number, showing that dense canopies and protective structures must be managed to avoid turning stress protection into light limitation. At the production-system level, density optimization can support profitability, labor efficiency, and lower input waste when paired with modern management. Mechanized pepper systems showed that reduced planting density improved working conditions while maintaining strong productivity in some settings, and sustainability assessment of greenhouse pepper in southeastern Spain found that a high-productivity system can remain environmentally and economically robust when adapted to changing inputs and resistant cultivars.

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