# 7 Case Study

## 7.1 Experimental design for biofertilizer application on a typical vegetable crop

A representative case study can be framed around field-grown tomato under conventional fertilization contrasted with a regime where mineral inputs are partially replaced by a Trichoderma-enriched bio-organic fertilizer. Ye et al. evaluated four fertilization strategies: full-rate chemical fertilizer (CF, 100% conventional NPK), reduced chemical fertilizer plus Trichoderma bio-organic fertilizer (75% NPK + BF), reduced NPK plus uninoculated organic fertilizer (OF), and reduced NPK plus Trichoderma spore suspension alone (SS), allowing isolation of microbial, organic-matter, and combined effects under realistic agronomic conditions (Ye et al., 2020). Experimental plots were arranged in a randomized design with multiple replicates, and both field and pot trials were implemented to capture responses across soil environments while controlling for confounding variation in microclimate and root-zone conditions (Ye et al., 2020).

A similar structure can be adapted for cucumber within organic or low-input systems, where biofertilizer is applied either via soil, foliar spray, or both. For instance, a randomized block 6 × 2 factorial design was used to test six concentrations of a liquid plant-based biofertilizer (0-5% in water) combined with presence or absence of soil application in organically grown Aodai cucumber, with four replications and eight plants per plot to ensure adequate statistical power (Da Silva Tamwing et al., 2020). Biofertilizer was applied at sowing to the soil and then at 7-day intervals via foliar sprays up to 28 days after sowing, with yield-related traits (fruit number, mean fruit mass, marketable yield) and morphological parameters (fruit length, diameter) measured at each harvest (Da Silva Tamwing et al., 2020). This kind of design, incorporating factorial combinations of dose and application pathway, is directly transferable to other greenhouse vegetable crops and enables optimization of biofertilizer regimes (Figure 2).

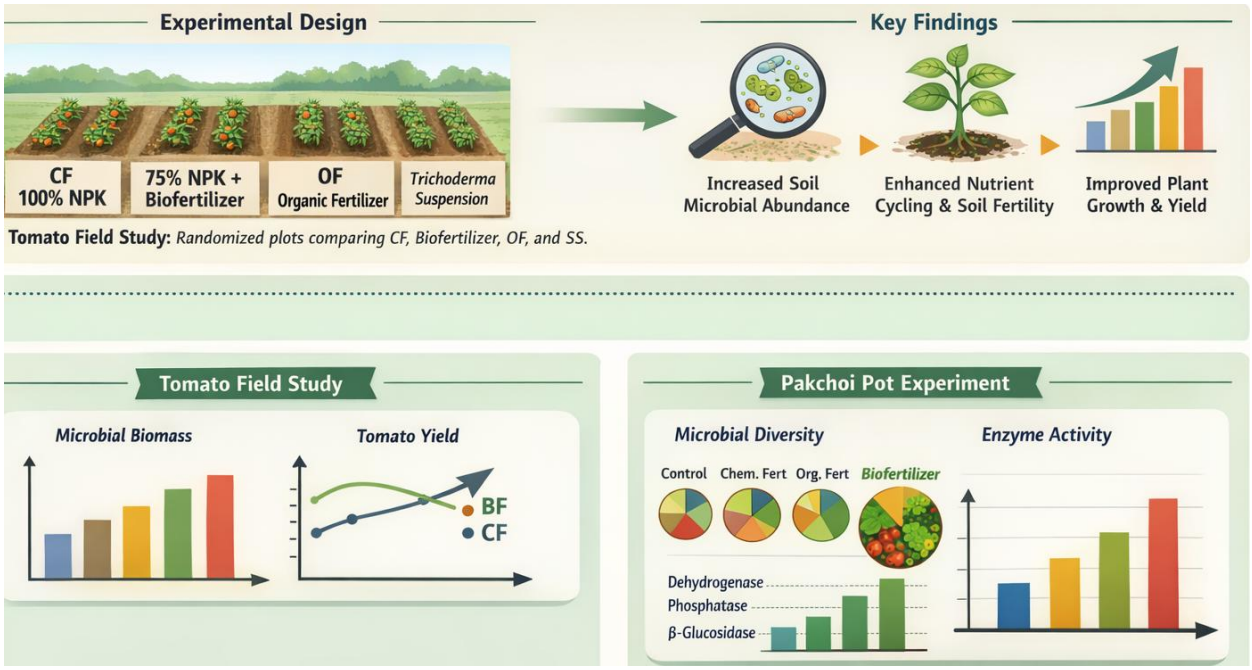


Figure 2 Experimental designs and key outcomes of biofertilizer application in vegetable crops

## 7.2 Changes in soil biological activity and data analysis

In the tomato case, reduced chemical fertilizer plus Trichoderma bio-organic fertilizer induced measurable shifts in soil biological activity relative to full mineral fertilization. Ye et al. observed that the BF treatment substantially increased soil microbial abundance and improved indices of soil fertility compared with CF, with many soil biological parameters showing significant positive linear relationships with yield, suggesting that enhanced microbial activity and community size mediated the agronomic response (Ye et al., 2020). In addition, correlations between microbial abundance and soil nutrient pools in BF-treated soils suggested a tighter coupling of mineralization and plant demand, helping to stabilize yields despite a 25% reduction in mineral inputs.