

A suitable case study should use a field-based comparative design that tests integrated management as a treatment package rather than as isolated inputs. In legumes, integrated crop management is defined as a site-specific combination of nutrient management, residue recycling, tillage, water management, crop diversification, varietal choice, and crop protection, and recent synthesis shows that the strongest benefits arise when rotation, conservation tillage, organic amendments, and microbiome management are combined rather than evaluated separately (Choudhary et al., 2020; Liang et al., 2025). For sword bean, this supports an experimental framework in which a control treatment is compared with several integrated packages differing in fertilizer source, irrigation regime, soil management, and cropping arrangement.

The treatment structure can be modeled on established legume experiments that compare organic, inorganic, and mixed nutrient strategies under replicated field conditions. A split-plot chickpea study used four nitrogen-management strategies-100% organic, 50:50 organic-inorganic, 75:25 organic-inorganic, and 100% inorganic RDF-with three replications, while a long-term maize-chickpea experiment tested 12 combinations of recommended NPK, FYM, poultry manure, compost, residues, and soil-test-based fertilization in a randomized complete block design. In sword bean, a comparable design could assign management packages to main plots and, where relevant, plant density or cropping system to subplots so that both main effects and interactions can be evaluated clearly.

Management treatments should also include practices beyond fertilization, because integrated performance depends on coordinated control of water, weeds, and soil physical condition. Legume reviews identify irrigation, sowing density, tillage, rhizobia application, and biostimulants as major agronomic levers affecting growth and quality, while integrated weed management remains important because weed competition can reduce legume yield by about 10-35% if not controlled during critical early growth stages (Karavidas et al., 2022). A sword bean case study is therefore strongest when nutrient treatments are paired with standardized weed control, stage-specific irrigation, and a clearly defined tillage or residue regime (Figure 2).

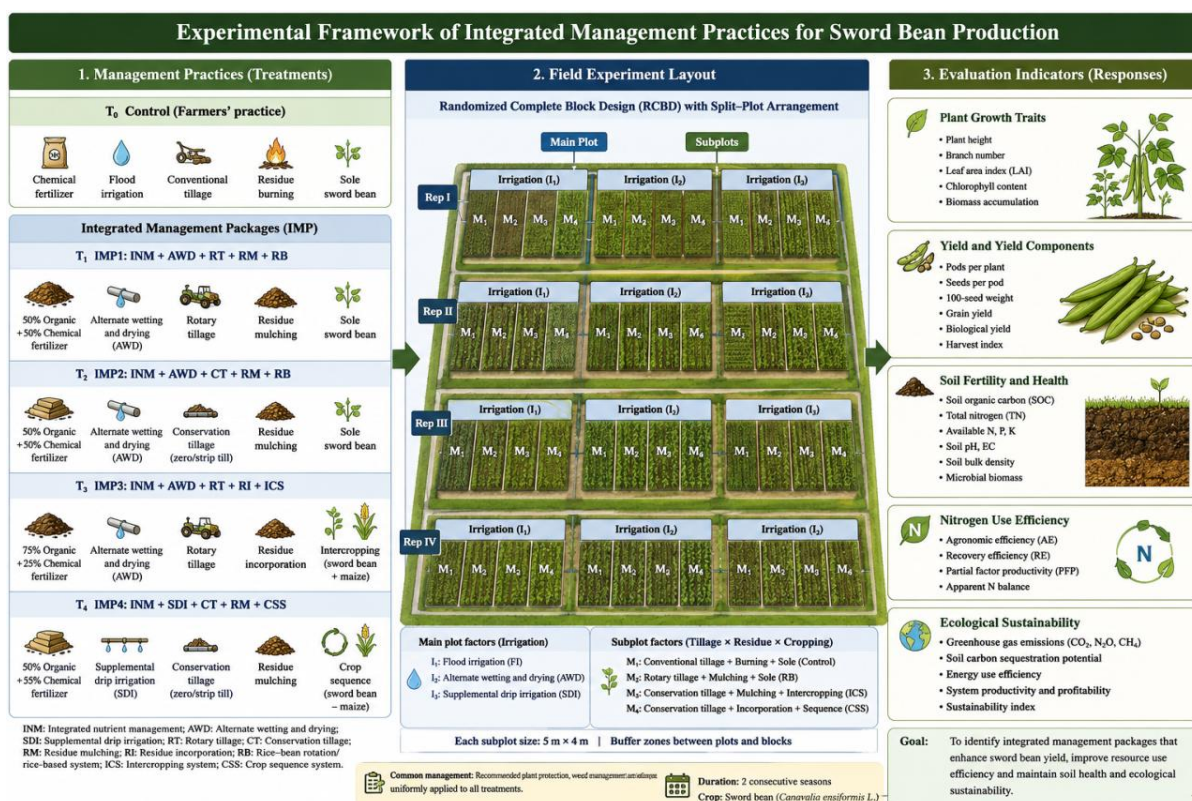


Figure 2 Experimental framework for evaluating integrated management strategies in sword bean production through combined manipulation of nutrient management, water regulation, soil practices, and cropping systems

Intercropping or rotation can be incorporated as an additional integrated-management factor where the objective