

Research Insight

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Growth Characteristics of Sword Bean under Different Management Practices

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Abstract Sword bean (*Canavalia gladiata*) is an important leguminous crop with high nutritional value, strong environmental adaptability, and potential applications in sustainable agricultural systems. However, its growth performance and productivity are strongly influenced by cultivation conditions and management practices. This review summarizes the effects of different management strategies, including nutrient management, water regulation, cultivation practices, and environmental control, on the growth characteristics of sword bean. The morphological development, physiological responses, biomass accumulation, and yield formation processes of sword bean under different management conditions are systematically discussed. Nutrient management, particularly the balanced application of nitrogen, phosphorus, potassium, and organic amendments, plays a critical role in promoting vegetative growth, improving photosynthetic efficiency, and enhancing nutrient use efficiency. Water availability and environmental factors such as temperature and light intensity further regulate root development, physiological activity, and stress adaptation capacity. In addition, cultivation practices, including planting density, tillage methods, intercropping, and crop rotation, influence canopy structure, resource utilization, and final productivity. A case study based on integrated management practices demonstrates that optimized combinations of fertilization, irrigation, and field management can significantly improve sword bean growth traits, yield performance, and agricultural sustainability. Despite these advances, further research is needed to clarify the interactions among genotype, environment, and management practices using physiological, molecular, and digital agricultural approaches. Future efforts should focus on developing precise and sustainable cultivation systems to maximize the production potential of sword bean. Overall, improving management practices provides an effective pathway for enhancing sword bean growth, productivity, and ecological benefits in modern agricultural systems.

Keywords Sword bean; Growth characteristics; Management practices; Nutrient management; Sustainable cultivation

1 Introduction

Sword bean (*Canavalia gladiata*) is an underutilized legume with clear potential for sustainable agriculture because it combines nutritional value with agronomic resilience. It has been described as a cheap source of protein and calories, and it also shows favorable agronomic traits for tropical cultivation, with average yields reported as comparable to soybean in suitable environments. Its broader significance lies in the fact that underutilized legumes can diversify food systems while improving resilience and food security, and sword bean has specifically been noted as having good agronomic properties that make it resilient to adverse climate conditions in the tropics.

Beyond its direct food value, sword bean also fits the ecological logic of low-input farming systems because, like other legumes, it can contribute to soil fertility and reduce reliance on synthetic nitrogen inputs. Reviews of legumes in sustainable systems emphasize that symbiotic nitrogen fixation is a major pathway by which legumes support environmentally friendly production and crop diversification, while bean-based systems more broadly can buffer productivity under variable weather and reduce dependence on environmentally unfriendly inputs. Sword bean itself has been described as a high-biomass, drought-tolerant, pest-resistant species with nitrogen-fixing ability expressed through root nodulation, traits that make it attractive not only as a grain crop but also as forage, green manure, and a multipurpose component of integrated farming systems.

Crop growth in legumes is strongly shaped by management, and sword bean is unlikely to be an exception. Across legume systems, phosphorus application and rhizobial inoculation consistently increase grain yield, biomass yield,