necessary to expand screening and evaluate new rootstock-scion combinations more systematically. This need is reinforced by the strong performance of alternative genetic resources, including interspecific hybrids and wild relatives, which can match or even substitute for *Solanum torvum* when compatibility and vigor are high. Recent studies show that rootstock optimization should be based not only on disease resistance or survival, but also on anatomical and physiological traits linked to final productivity. In grafted eggplant, larger root volume, wider xylem, and higher cortex cell number were associated with higher yield, indicating that internal rootstock structure can serve as a more informative selection criterion than gross compatibility alone (Kappel et al., 2024). At the same time, practical screening continues to identify robust candidates such as *S. torvum*, *S. sisymbriifolium*, and *S. incanum* for multi-disease resistance, which is directly relevant for breeding next-generation rootstocks with broader adaptation (Akanksha et al., 2025).

Optimization also extends to the grafting process itself, where high success rates depend on both biological compatibility and technical precision. In eggplant relatives, some interspecific hybrids achieved at least 90% germination and 100% graft success, showing that appropriate rootstock genetics can simplify nursery operations as well as improve field performance. Comparable evidence from alternative rootstock programs found high grafting success for selected materials such as SPA and the hybrids Msa 2/2 E7 and 460 CAL, supporting continued diversification of nursery-ready rootstocks (Du et al., 2024). Method optimization is increasingly tied to automation because manual grafting limits scale, uniformity, and labor efficiency. A fully automatic synchronized grafting machine developed for eggplant tray seedlings achieved 700 grafts per hour, about 95% average success, and zero stem damage, indicating that machine-assisted grafting can improve both throughput and seedling quality (Liu et al., 2025). A separate comparison of manual and robotic brinjal grafting likewise found faster healing, about 96.3% success, and about 689.5 grafts per hour in the best robotic treatment with *S. torvum*, suggesting that future optimization will combine superior rootstocks with precision nursery engineering.

7.2 Integration of grafting with modern agricultural technologies

A major future direction is the integration of grafting with other sustainable crop-management tools rather than using grafting as a stand-alone intervention. Combined strategies are already showing clear benefits in eggplant, particularly when grafted plants are paired with microbial or biological inputs that improve nutrient uptake, stress buffering, and fruit functional quality. This shift matters because plant responses to grafting remain genotype- and environment-dependent, so integrated protocols are needed to stabilize outcomes across production systems (Kıran et al., 2026). *Arbuscular mycorrhiza* represents one of the clearest examples of productive integration. Under greenhouse conditions, AM fungi increased marketable fruit, fruit number, and nitrogen use efficiency regardless of graft combination, while the B/T and B/P grafts combined with AMF delivered the best overall results for yield traits, mineral profile, and nutritional quality (Sabatino et al., 2020). These findings suggest that future protected-cultivation systems can use grafting as a structural platform onto which beneficial symbionts are added to enhance nutrient acquisition and functional quality.

Biostimulants and organic amendments provide a second integration pathway. In eggplant, *Azospirillum brasilense* combined with *S. torvum* or *S. aethiopicum* rootstocks enhanced growth, yield, nutritional traits, and nitrogen use efficiency, and the authors identified these combinations as useful for plug-plant production systems seeking more sustainable performance (Consentino et al., 2022). More recent drought-management work similarly showed that combining grafted plants with vermicompost improved yield, soil moisture, mineral status, and antioxidant-related quality traits under greenhouse and field stress, supporting integrated low-input strategies for climate-resilient production (Kıran et al., 2026). Digitalization and mechanization are likely to shape the next phase of adoption. Reviews of grafting technology argue that specialized nurseries equipped with advanced seeders, growth chambers, and acclimatization facilities can improve seedling uniformity, while databases, crop models, and mobile tools could help growers choose the most suitable rootstock-scion combinations (Awazade and Verma, 2024). In parallel, grafting-robot reviews conclude that further progress depends on better machine vision, artificial intelligence, and tighter integration between robotics and seedling biotechnology to produce more universal and intelligent systems (Yan et al., 2022).