

表 3 育种模块与数字化/AI 集成方式

Table 3 Integration mode of breeding CRO service module with digitalization/AI

服务模块 Service module	关键活动/技术 Key activities / technologies	数字化/AI 集成形式 Digital/AI integration formats
试验设计 Trial design	杂交方案设计, 群体规划, 标记/基因编辑方案 Design of hybridization schemes, population planning, and marker/gene-editing schemes	模拟分析, 预测模型 Simulation analysis and predictive models
实验室与田间执行 Laboratory and field execution	PCR/qPCR, 转基因事件验证, 田间试验, 多点布置 PCR/qPCR, transgenic event verification, field trials, and multi-location layout	高通量平台、遥感与高通量表型 High-throughput platforms, remote sensing, and high-throughput phenotyping
数据分析与成果交付 Data analysis and deliverables	多性状模型, G×E 分析, 数据可视化, AI 辅助分析 Multi-trait models, G×E analysis, data visualization, and AI-assisted analysis	机器学习模型, 交互式决策仪表盘 Machine learning models and interactive decision dashboards
合规与监管支持 Compliance and regulatory support	GLP 体系, GMO/品种登记, 审计追踪 GLP systems, GMO/variety registration, and audit trails	数字化审计系统、文档管理平台 Digital audit systems and document management platforms
扩展服务模块 Extended service modules	技术转移验证, AI 平台集成, 云端育种数据库建设 Technology transfer validation, AI platform integration, and construction of cloud-based breeding databases	云端数据库, AI 分析流水线、数据服务接口 Cloud databases, AI analysis pipelines, and data service interfaces