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TECHNOLOGY FOR PRODUCING HEALTHY GRAPEVINE PLANTING MATERIAL OF PROMISING CULTIVARS IN THE FERGANA VALLEY USING IN VITRO BIOTIZATION AND BIOLOGICAL PROTECTION AGENTS

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Abstract. This thesis examines a technology for producing healthy planting material of promising grapevine (Vitis vinifera L.) cultivars under the environmental conditions of the Fergana Valley. The proposed system integrates phytosanitary selection, pathogen diagnostics, in vitro micropropagation, root induction, gradual acclimatization, biotization with beneficial microorganisms, and biological protection in the nursery. Special attention is given to preserving cultivar identity, reducing transplantation stress, and preventing reinfection. The approach is a literature-based technological proposal; experimental performance indicators require local validation.

Keywords: grapevine, Fergana Valley, in vitro culture, micropropagation, biotization, Trichoderma, Bacillus, biological protection, healthy seedlings.

Annotatsiya. Tezisda Farg‘ona vodiysi sharoitida istiqbolli uzum navlarining sog‘lomlashtirilgan ko‘chatlarini yetishtirish texnologiyasi ko‘rib chiqiladi. Taklif etilgan tizim fitosanitar tanlash, patogenlarni diagnostika qilish, in vitro mikroko‘paytirish, ildizlantirish, moslashtirish, foydali mikroorganizmlar bilan biotizatsiya va ko‘chatzorda biologik himoyani birlashtiradi. Mazkur yondashuv adabiyotlar tahliliga asoslangan bo‘lib, samaradorligi mahalliy tajribalarda tekshirilishi zarur.

Kalit so‘zlar: uzum, Farg‘ona vodiysi, in vitro, mikroko‘paytirish, biotizatsiya, Trichoderma, Bacillus, biologik himoya, sog‘lom ko‘chat.

Аннотация. Рассматривается технология получения оздоровленного посадочного материала перспективных сортов винограда в условиях Ферганской долины. Предлагаемая система объединяет фитосанитарный отбор, диагностику патогенов, микроразмножение in vitro, укоренение, акклиматизацию, биотизацию полезными микроорганизмами и биологическую защиту в питомнике. Подход основан на анализе литературы и требует местной экспериментальной проверки.

Ключевые слова: виноград, Ферганская долина, in vitro, микроразмножение, биотизация, Trichoderma, Bacillus, биологическая защита, оздоровленные саженцы.

INTRODUCTION

Viticulture has considerable economic importance in the Fergana Valley, where warm growing seasons and varied irrigation and soil conditions create opportunities for high-quality table and processing grapes. The development of productive vineyards, however, depends on genetically authentic and phytosanitarily reliable planting material. Conventional propagation from cuttings can perpetuate systemic pathogens, while nursery-stage infections and water or temperature stress may lower seedling quality. FAO guidance identifies virus-tested source material and prevention of reinfection as core principles of grapevine sanitation [1].

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In vitro propagation permits rapid multiplication from selected mother plants in controlled conditions. Nevertheless, aseptic culture alone does not prove that plants are free from viruses or other systemic pathogens. Furthermore, plantlets developed under high humidity and low mechanical stress may have difficulties after transfer to ex vitro conditions. Biotization, understood here as the deliberate establishment of compatible beneficial microorganisms during acclimatization, may complement sanitation and help nursery establishment. The aim of this thesis is to formulate an integrated and locally adaptable production scheme rather than report unperformed field experiments.

MAIN PART

Selection and health verification of source plants. Mother vines should be identified by cultivar and clonal characteristics, inspected for symptoms, and tested for priority grapevine viruses using validated laboratory methods such as ELISA or RT-PCR, according to available diagnostics and nursery certification requirements. The distinction between visually healthy and diagnostically tested material is fundamental [1, 2]. If infection is detected, meristem-tip culture combined where suitable with thermotherapy or other approved sanitation methods may be considered, followed by repeated diagnostic testing. No plant should be described as virus-free solely because it survived surface sterilization.

Establishment and multiplication of aseptic cultures. Young shoots collected from verified donor vines are cleaned and surface-disinfected according to explant sensitivity. Nodal segments or shoot tips are then placed on a sterile basal nutrient medium, commonly derived from the Murashige–Skoog formulation [3]. Cytokinin type and concentration should be optimized cultivar by cultivar to obtain healthy shoot proliferation without excessive callusing, hyperhydricity, or morphological variation. Repeated subculturing must be limited and recorded to preserve genetic fidelity. Aseptic multiplication is performed with regular screening for contamination, abnormal growth, and possible cultivar mix-ups.

Root induction and ex vitro acclimatization. Microshoots are transferred to a rooting stage with a suitable auxin regime or, when the cultivar allows, a low-regulator medium. Well-rooted plantlets are carefully removed from vessels, cleaned of remaining medium, and transplanted into a disinfected, well-aerated substrate. Humidity is initially maintained at an elevated level, then progressively reduced while light intensity and ventilation are increased. Monitoring should include rooting percentage, root quality, survival after transplanting, leaf development, and growth uniformity. Micropropagation principles emphasize gradual adaptation to avoid dehydration and transplant shock [4].

Biotization and biological protection. Following transfer from sterile culture, the root zone may be inoculated with a quality-controlled, compatible preparation of Trichoderma spp. or Bacillus spp., only after small-scale trials establish compatibility with the substrate, irrigation water, and selected grapevine cultivars. Candidate agents can contribute through competition with pathogens, antimicrobial metabolites, induced plant defenses, and improved root-zone functioning. Research on grapevine trunk diseases indicates that Trichoderma-based approaches can reduce certain infections, but effects vary with strain, application time, pathogen, and setting [5–7]. Biological inoculation must not be represented as a cure for systemic viral infection or a replacement for phytosanitary testing.

Adaptation to the Fergana Valley. Local nursery protocols should account for hot and dry periods, irrigation-water quality, occasional salinity, and seasonal temperature fluctuations. Hardened plants should be transferred to shaded or protected nursery areas, irrigated according to substrate moisture rather than a fixed schedule, and examined regularly for root or stem disease. Biological agents should be applied according to tested formulation labels and relevant national registration requirements; preventive hygiene, clean tools, separation of production batches, and insect-vector monitoring remain essential. The recent concept of integrating clonal selection, diagnostic testing,

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sanitation, retesting, and maintenance of initial mother plants supports such a quality-assured system [2].

Quality-control and evaluation framework. An applied experiment can compare: (i) conventional acclimatization without inoculation; (ii) inoculation with a selected Trichoderma strain; (iii) inoculation with a selected Bacillus strain; and (iv) a compatibility-tested combined treatment. Each treatment should use randomized replicated batches within each cultivar. Measurable outcomes include contamination during culture, shoot multiplication coefficient, rooting rate, ex vitro survival at 30 and 60 days, root and shoot biomass, disease incidence, and final percentage of certifiable seedlings. Statistical analysis should test cultivar, treatment, and their interaction. These are proposed evaluation criteria, not observed findings.

CONCLUSION

A coherent production pathway for promising grapevine cultivars in the Fergana Valley should connect verified healthy mother plants, diagnostic testing, controlled in vitro multiplication, reliable rooting, gradual acclimatization, targeted biotization, and hygienic nursery management. Beneficial microorganisms may enhance establishment and offer supplementary protection from certain fungal pathogens, but their performance must be confirmed for local strains, cultivars, and nursery conditions. The principal practical recommendation is to pilot and standardize the whole production chain, with repeat testing and traceability, before large-scale deployment.

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