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Cultivation of Bitter Almond (Amygdalus scoparia Amygdalus communis var. amara) in Foothill and Pasture Zones: Ecological Foundations, Agro-Techniques, and Environmental Restoration

Bobomurodov Zokir Abduqaxxorovich
Jizzakh State Pedagogical University Professor, Department of Biology
Shavkatjanova Malika Furqatovna
Doctoral Student Department of Biology, Jizzakh State Pedagogical University
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O'zbek tilida annotatsiya: Ushbu maqolada tog‘ oldi va yaylov hududlarining qurg‘oqchil va yarim qurg‘oqchil sharoitlarida achchiq bodom (Amygdalus) o‘simligini yetishtirishning ekologik asoslari, biologik xususiyatlari va agrotexnik usullari yoritilgan. Achchiq bodomning qurg‘oqchilikka chidamliligi, chuqur ildiz tizimi tuproq eroziyasining oldini olishda va degradatsiyaga uchragan yaylovlarni tiklashda muhim ahamiyat kasb etishi ko‘rsatib o‘tilgan. Shuningdek, urug‘larni stratifikatsiya qilish, ekish muddatlari, parvarishlash qoidalari hamda uning farmatsevtika, kosmetika va qishloq xo‘jaligidagi iqtisodiy salohiyati tahlil qilingan.

Аннотация на русском языке: В данной статье рассмотрены экологические основы, биологические особенности и агротехнические приемы выращивания горького миндаля (Amygdalus) в засушливых и полузасушливых условиях предгорных и пастбищных зон. Показано, что засухоустойчивость горького миндаля и его мощная корневая система имеют важное значение для предотвращения эрозии почв и восстановления деградированных пастбищ. Также проанализированы методы стратификации семян, сроки посадки, правила ухода и его экономический потенциал в фармацевтике, косметике и сельском хозяйстве.

English Annotation: This article explores the ecological foundations, biological characteristics, and agro-technological methods for cultivating bitter almond (Amygdalus) in the arid and semi-arid conditions of foothill and pasture zones. It highlights how the exceptional drought tolerance and deep root system of bitter almond play a crucial role in preventing soil erosion and rehabilitating degraded rangelands. Furthermore, the paper analyzes seed stratification methods, planting schedules, maintenance practices, and its economic potential in the pharmaceutical, cosmetic, and agricultural sectors.

Introduction

Arid and semi-arid foothill regions (adirs) are frequently subject to soil degradation, water erosion, and overgrazing. Restoring these degraded rangelands requires resilient, xerophytic plant species that can withstand low precipitation, high solar radiation, and poor soil conditions. Bitter almond (Amygdalus L.) naturally thrives in arid mountainous and foothill landscapes across Central Asia and the Mediterranean basin. Beyond its natural ecological distribution, bitter almond serves as a valuable multi-purpose crop. Its deep taproot system prevents soil erosion on steep slopes, while its seeds, oil, and secondary metabolites hold significant value in pharmacology, cosmetics, and as rootstocks for sweet almond cultivation. Developing structured agro-techniques for cultivating bitter almond in foothill pastures offers a sustainable pathway for wasteland reclamation and ecological management.

2. Ecological and Biological Characteristics

Successful cultivation in pasture zones depends on a thorough understanding of the plant's biological adaptations:

- **Drought and Heat Resistance:** Bitter almonds possess xeromorphic leaf structures, thick cuticles, and extensive root systems capable of tapping deep moisture reserves in rocky and gravelly soils.
- **Soil Adaptability:** It grows vigorously on calcareous, stony, and serozem (gray) soils typical of foothill zones, preferring well-drained slopes with a pH ranging from mildly acidic to alkaline.
- **Light Requirements:** As an obligate heliophyte, it requires full, unshaded sunlight for optimal canopy development, flower bud differentiation, and fruit set.
- **Hardiness:** Most wild-adapted species tolerate wide temperature fluctuations, surviving cold winters and scorching summer droughts.

3. Agro-Techniques for Cultivation in Foothill Zones

3.1. Site Selection and Land Preparation

- **Topography:** South-, southwest-, or southeast-facing foothill slopes with gentle to moderate inclines (up to 15–20 degrees) are ideal. Steep slopes require contour trenching or terracing to capture precipitation and prevent runoff.
- **Soil Preparation:** Deep ripping or contour plowing is performed in late autumn to break up subsurface compaction, improve moisture infiltration, and clear perennial weeds.

3.2. Propagation and Seed Treatment

While budding and grafting onto seedling rootstocks are common for orchard production, direct seeding or containerized seedling plantation is preferred for large-scale foothill and pasture restoration:

- **Stratification:** Seeds (nuts) require cold stratification to break dormancy. Seeds are mixed with moist sand and stored at temperatures between 2°C and 5°C for 60 to 90 days before spring sowing. Alternatively, autumn direct seeding can be utilized, allowing natural winter chilling to break dormancy.
- **Sowing Depth:** Seeds are planted at a depth of 5 to 7 cm, spaced appropriately depending on the restoration goal (e.g., dense hedgerows for erosion control vs. wider spacing for agroforestry).

3.3. Planting and Care

- **Timing:** Early spring (as soon as the soil is workable) or late autumn represents the optimal planting window.
- **Irrigation:** Although drought-tolerant, supplemental irrigation during the first one to two growing seasons significantly increases establishment rates and root development. Once established, plants rely entirely on atmospheric precipitation.
- **Protection:** Young plantations must be protected from livestock grazing and rodent damage during the establishment phase through rotational grazing bans or temporary fencing.

4. Ecological and Economic Significance

4.1. Environmental Restoration

- **Anti-Erosion Effect:** The extensive root network binds loose soil particles on slopes, dramatically reducing wind and water erosion.

- **Biodiversity Enhancement:** Flowering bitter almond trees provide an early nectar source for native pollinators, including wild bees and beneficial insects, supporting broader ecosystem health in degraded rangelands.

4.2. Economic Potential

- **Pharmaceutical and Cosmetic Industry:** Bitter almond kernels and extracted essential oils are rich in amygdalin and fatty acids, making them valuable for medicinal preparations and cosmetic formulations.
- **Rootstock Utilization:** Seedlings serve as exceptionally hardy, disease-resistant rootstocks for cultivated sweet almond (Prunus dulcis) varieties in non-irrigated or dryland farming systems.

5. Conclusion

Cultivating bitter almond in foothill and pasture zones bridges the gap between environmental conservation and sustainable resource management. By utilizing its natural resilience to drought and poor soils, land managers can effectively combat soil erosion, restore degraded rangelands, and create sustainable economic value in arid regions. Future efforts should focus on selecting superior local accessions and integrating bitter almond into broader agroforestry frameworks.

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