American Journal of Biodiversity
https://biojournals.us/index.php/AJB
ISSN: 2997-3600

Botanical Characteristics of the Red Maple (Acer Rubrum) In Samarkand Region: Adaptation to Climate, Soil, and Flora

Baratov Kamol Urolboy o'g'li
Doctoral student, Samarkand state university of veterinary medicine, livestock and biotechnologies

Kuchkarova Zarifa Donyorxon qizi
Master's Samarkand state university of veterinary medicine, livestock and biotechnologies

Shernazarov Shavkat Shuhratovich
PhD, dotsent, Samarkand state university of veterinary medicine, livestock and biotechnologies

Received: 2025, 15, Aug
Accepted: 2025, 21, Sep
Published: 2025, 10, Oct

Annotation: This article examines the botanical characteristics of the red maple (Acer rubrum) and its growth and development features under the climatic and soil conditions of the Samarkand region. The study highlights that red maple can adapt to different soils and moisture levels but faces challenges under prolonged drought, as well as summer climatic and soil stresses. The findings show that climatic and edaphic factors largely determine the distribution and survival of red maple in this environment. Overall, red maple is presented as a model for resilience and ecological responses in the conditions of Samarkand.

Keywords: botanical characteristics, continental climate, sierozem soils, loess soils, saline soils, ephemeral vegetation, halophytes, gypsophytes, juniper woodlands, drought tolerance, plant adaptations, arid ecosystems,

desert shrublands, growth rates, ecological adaptations, drought sensitivity, soil preference, root system plasticity, wind and insect pollination.

The Red maple (Acer rubrum L.) belongs to the family Sapindaceae and the section Acer sect. Rubra. It is one of the most widely distributed and abundant deciduous trees in eastern North America, ranging from Canada to the central and eastern United States. Within North American floristics, several infraspecific taxa are recognized, including var. rubrum, var. trilobum, and var. drummondii. This species is a medium-to-large deciduous tree that typically reaches 20–30 (occasionally up to 35) meters in height. The crown form is rounded to oval in open-grown individuals, with ascending branches, while the bark is smooth and pale gray on young stems, later becoming darker and breaking into shallow plates with age. The twigs are brown to purplish, bearing conspicuous lenticels, and the imbricate winter buds are reddish-green. The wood is diffuse-porous and commercially used as “soft maple.” Leaves are opposite, simple, and usually three- to five-lobed with serrated margins. The blades measure about 5–10 cm in both length and width, with shallow to moderately incised sinuses that distinguish them from the deeper-lobed Acer saccharinum. The petioles are slender and characteristically red, often reaching 10 cm. The abaxial surface of the leaf is pale and may be glaucous or pubescent along the veins. Seasonal coloration varies considerably among individuals, ranging from yellow and orange to the more typical bright scarlet, which contributes to the species’ ornamental value. Red maple displays a polygamodioecious reproductive system, with populations containing male, female, and monoecious individuals. Functional sex expression may shift between years in the same tree, a phenomenon documented in long-term studies. The species flowers very early in spring, often before leaf-out. The small, red flowers are clustered at twig tips, followed by paired samaras approximately 15–25 mm long, with slightly divergent wings. Unlike many other maples, the fruits mature in spring (April–June), and the seeds germinate soon after dispersal. Growth rate is moderate to fast, with typical lifespans under 100–150 years in natural forests. The root system exhibits remarkable plasticity: on wet soils, seedlings form short taproots with long lateral roots, while on drier soils, they develop longer taproots with fewer laterals. Mature trees generally possess horizontal woody roots concentrated in the upper 25 cm of soil. Ecologically, Acer rubrum is notable as an edaphic generalist, occurring on wet bottomlands tolerant of seasonal flooding as well as on dry upland sites. However, chlorosis can occur on high-pH soils. Field identification relies on several diagnostic features: the reddish coloration of petioles, buds, twigs, flowers, and young fruits; the early phenology of flowering and fruiting compared with co-occurring hardwoods; and the distinctive transition in bark texture from smooth gray in juveniles to plated surfaces in maturity. Due to its abundance, ecological adaptability, and striking seasonal foliage, Acer rubrum is both a dominant species in many forest ecosystems and a highly valued ornamental tree. It is globally assessed as Least Concern by the IUCN, reflecting its stable populations and wide distribution.

While not native to Central Asia, the red maple (*Acer rubrum*) is a useful example of how a plant species can adapt to a wide range of environmental conditions. *Acer rubrum* is a deciduous tree indigenous to eastern North America (often called “swamp maple” or “red maple”). It is renowned for being one of the most widespread and adaptable hardwood tree species on that continent. Red maple’s native range spans from wet bottomland forests to dry upland ridges, reflecting a remarkable ecological amplitude. In fact, botanists note that *Acer rubrum* can thrive on a wider range of soil types, moisture regimes, pH levels, and elevations than perhaps any other North American forest species. It is found in ecosystems ranging from peaty swamps and bogs to rocky, well-drained slopes, tolerating conditions that vary from very wet to fairly dry. This plasticity is evident in its root system development: red maple seedlings will adjust their

root characteristics depending on soil moisture – for instance, forming deeper rooting in dry soil versus shallower, fibrous roots in waterlogged soil, thereby maximizing water uptake in either case.

Red maple's broad environmental tolerance is supported by several botanical features. It prefers slightly acidic, moist soils and is often dominant in swampy areas (hence "swamp maple"), but it also grows surprisingly well on average loams, clays, or sandy soils if those soils are not highly alkaline. In cultivation it has been observed to handle anything from extended flooding (its seedlings can survive inundation) to reasonably well-drained upland soil. However, red maple's versatility does have limits: it has only moderate drought tolerance and in nature it tends to hug areas with reliable moisture unless planted in cooler climates. In the northern part of its range (with cooler summers), red maple even occupies dry, sandy ridgetops, whereas in the hotter southern range it is confined mostly to wet habitats, illustrating how climate interacts with its drought tolerance. Notably, *Acer rubrum* does not thrive on highly alkaline soils – it grows poorly on calcareous sites, which underscores that even a "generalist" tree has specific edaphic boundaries. Beyond edaphic adaptability, *Acer rubrum* is also phenotypically flexible. It can grow as a 60–75 ft tall shade tree with a single trunk in deep soils, or remain a smaller, multi-stemmed tree in poorer, drier sitesIt is one of the first trees to flower in late winter/early spring, with red blossoms emerging even on leafless branches, and it produces abundant winged seeds (samaras) that disperse widely each spring. This prolific seeding and the ability to germinate on a variety of seedbeds (from moist leaf litter to mineral soil) allow red maple to colonize disturbed areas readily. Its leaves turn brilliant shades of red and orange in autumn, an adaptation for energy resorption, and perhaps also providing frost tolerance by shedding leaves before winter. The species' wide climatic tolerance is evidenced by its presence from southern Canada (hardiness zone 3) down to Florida (zone 9). It withstands freezing winters in the north and hot, humid summers in the south, as long as sufficient soil moisture is available. Indeed, *Acer rubrum*'s absence in the driest mid-continental prairies is not due to an absolute rainfall requirement (it grows in other regions with similar low precipitation) but likely due to historical factors and competition in those ecosystems.

In summary, *Acer rubrum* exemplifies botanical adaptability: it tolerates a very wide range of soils – from waterlogged peat to dry sand – and can grow under both sunny and partially shaded conditions. This has made it a "foolproof" shade tree in horticulture and contributed to its dominance in many eastern U.S. forests. The red maple's success across diverse environments underscores how a single species can possess plastic traits (rooting pattern, phenology, physiology) that allow it to adjust to local soil and climate conditions. Such versatility is one reason *Acer rubrum* is found in 56 out of 88 forest cover types defined for eastern North America – it associates with an enormous variety of other trees from wetlands to uplands. Whether in a New England swamp or on an Appalachian hillside, the red maple's ability to "read" the site and modify its growth accordingly is key to its survival. This broad tolerance illustrates the concept of adaptive range in botany, complementing the more specialized adaptations we see in Samarkand's flora. Together, these examples highlight how soil and climate factors shape plant distribution: some species like red maple become versatile generalists across climates, while others evolve narrow specializations to thrive in one harsh locale, as in Samarkand.

References

1. FAO (2005). Agro-Ecological Zones of Uzbekistan. Rome: Food and Agriculture Organization of the United Nations.
2. Shomurodov, H., Toderich, K., & Sato, T. (2017). Vegetation and plant adaptations in Central Asian mountain regions. American Journal of Plant Sciences , 8(7), 137–153.
3. FAO (2019). Forestry of Uzbekistan Report. Rome: Food and Agriculture Organization of the United Nations.

4. Walters, R. S., & Yawney, H. W. (1990). Acer rubrum L. Red Maple. In Silvics of North America: Volume 2. Hardwoods* (pp. 60–69). USDA Forest Service.
5. Gilman, E. F., & Watson, D. G. (2014). Acer rubrum: Red Maple. University of Florida IFAS Extension.
6. **6.**FAO – *Agro-Ecological Zones of Uzbekistan* (climate and soil in Samarkand foothills)
7. K.U.Baratov.,Sh.Sh.Shernazarov.,T.N.Tuyg‘unov.,M.M.Mengboyeva. Qizil bargli zarang (acer rubrum) o’simligidan ko’kalamzorlashtirishda foydalanishning istiqbollari. Xorazm ma’mun akademiyasi axborotnomasi. 2024-11/1. (120) 2024 y., noyabr (page 23-25)
8. Baratov Kamol Urolboy o‘g‘li., Shernazarov Shavkat Shuhratovich. In vitro microclonal propagation of red maple (Acer rubrum l.) under Samarkand region. 05, May, 2025 y. page (539-546)