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Dosanova Gulchira Angsatbaevna

Bioecological Characteristics of Capparis spinosa (Capparis spinosa L.)

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ABSTRACT

Capparis spinosa L., commonly known as caper bush, is a perennial xerophytic shrub widely distributed in arid and semi-arid regions of the Mediterranean basin, Central Asia, and parts of North Africa. The species is highly adapted to extreme environmental conditions such as drought, high temperatures, saline soils, and rocky substrates. This paper summarizes the bioecological characteristics of C. spinosa, including its morphological traits, ecological requirements, physiological adaptations, reproductive biology, and distribution patterns. The plant is ecologically significant for soil stabilization and desertification control, while also having high economic value due to its edible flower buds and medicinal properties.

Capparis spinosa L. is a well-known perennial shrub belonging to the family Capparaceae. It is naturally distributed in Mediterranean ecosystems but is also found in Central Asia, including arid regions where environmental conditions are harsh and vegetation cover is sparse. The species has attracted scientific interest due to its strong ecological adaptability and economic importance. The plant thrives in rocky cliffs, dry slopes, wastelands, and marginal soils where few other plant species can survive. Its ability to tolerate drought, high solar radiation, and poor soil fertility makes it an important species in ecological restoration and soil conservation programs. In addition to its ecological role, C. spinosa is widely used in traditional medicine and culinary practices. Its flower buds, known as capers, are a valuable spice in Mediterranean cuisine. Therefore, understanding its bioecological characteristics is essential for conservation, cultivation, and sustainable use.

Morphological Characteristics

Capparis spinosa L. is a perennial xerophytic shrub characterized by a highly specialized morphological structure adapted to arid environments. The plant typically has prostrate or trailing stems that can extend 1–2 meters in length. These stems are flexible, allowing the plant to spread across rocky surfaces and stabilize itself in unstable habitats. The leaves are simple, round to ovate, thick, and covered with a waxy cuticle that significantly reduces water loss through transpiration. This adaptation is essential for survival in hot and dry climates.[1] The root system of C. spinosa is deep and well-branched, enabling access to underground

moisture sources. This feature is one of the key survival mechanisms in desert ecosystems. The plant produces large, attractive flowers that are white to pinkish in color with prominent purple stamens. These flowers are short-lived but highly efficient in attracting pollinators such as bees. The fruit is a fleshy berry containing numerous seeds, which are dispersed mainly by birds and small animals. Overall, the morphological structure of C. spinosa reflects its adaptation to harsh ecological conditions and contributes to its resilience in poor soils and rocky habitats.[2]

Ecological Requirements and Habitat

Capparis spinosa thrives in extreme ecological conditions where most plant species cannot survive. It is commonly found in Mediterranean climates as well as arid and semi-arid regions of Central Asia, North Africa, and the Middle East. The species prefers rocky slopes, limestone outcrops, sandy soils, and disturbed lands with minimal vegetation cover. It is highly tolerant to drought, high temperatures, and strong solar radiation, making it a typical xerophytic plant. The plant demonstrates remarkable adaptability to poor soil fertility and can grow in saline and alkaline soils. It does not require high nutrient availability, which allows it to colonize marginal and degraded lands. Seasonal rainfall is often the only source of water for its growth, and it survives long dry periods by reducing metabolic activity. Temperature tolerance is also high, withstanding hot summers and relatively mild winters. Ecologically, C. spinosa plays an important role in preventing soil erosion and stabilizing rocky terrains. Its presence contributes to the maintenance of biodiversity in desert ecosystems by providing food and shelter for insects and birds. Because of its resilience, it is also considered a valuable species in ecological restoration projects and desertification control programs.[4]

Physiological and Ecological Adaptations

The survival of Capparis spinosa in harsh environments is supported by a range of physiological and ecological adaptations. One of the most important adaptations is its efficient water-use strategy. The plant has a thick cuticle layer and reduced leaf surface area, which minimize water loss through evaporation. Additionally, stomatal regulation allows the plant to control transpiration effectively during periods of extreme heat and drought. The root system is another critical adaptation. It is deep and extensive, enabling the plant to access underground water reserves that are unavailable to many other species. During prolonged drought conditions, C. spinosa can enter a semi-dormant state, significantly reducing its metabolic activity to conserve energy and water.[5] The plant also shows a high level of salt tolerance, allowing it to grow in saline soils where many crops cannot survive. Cellular mechanisms help maintain ion balance and prevent salt toxicity. Furthermore, its reproductive strategy ensures survival in unstable environments; it produces abundant seeds with hard coats that can remain dormant until favorable conditions arise. These combined physiological mechanisms make Capparis spinosa one of the most resilient plant species in arid ecosystems and an important model for studying drought resistance and ecological adaptation.

Reproductive Biology

The reproductive biology of Capparis spinosa is well adapted to its environment and ensures successful survival in harsh ecological conditions. The plant reproduces both sexually

through seeds and vegetatively through stem cuttings. Sexual reproduction is primarily dependent on insect pollination, especially bees, which are attracted by the plant's large and colorful flowers. The flowering period usually occurs during late spring and summer when pollinator activity is high. Each flower has a short lifespan, often opening in the morning and closing by evening. Despite this short duration, the plant produces a large number of flowers over the flowering season, increasing the chances of successful pollination. The fruit is a fleshy berry containing numerous seeds. These seeds are dispersed by birds and small animals, contributing to the wide distribution of the species. Seed germination is naturally slow due to the hard seed coat, which acts as a dormancy mechanism. This ensures that seeds only germinate under favorable environmental conditions. Vegetative reproduction through stem cuttings is also common, especially in cultivated environments, as it allows faster propagation and genetic stability. Overall, the reproductive strategy of C. spinosa ensures both survival and adaptability, making it highly successful in unstable and resource-limited ecosystems.

Distribution and Ecological Importance

Capparis spinosa has a wide geographical distribution across arid and semi-arid regions of the world. It is native to the Mediterranean Basin but is also found in Central Asia, including Uzbekistan and neighboring countries, as well as North Africa and parts of the Middle East. The species typically grows in dry, rocky, and marginal lands where environmental conditions are too harsh for most vegetation. Ecologically, C. spinosa plays an important role in stabilizing soil and preventing erosion. Its extensive root system helps bind loose soil and rock particles, reducing the risk of land degradation. The plant also contributes to desert ecosystem biodiversity by providing nectar for pollinators and food for birds and insects. From an economic perspective, C. spinosa is widely valued for its flower buds, known as capers, which are used in culinary industries around the world. In addition, it has medicinal importance due to its antioxidant, anti-inflammatory, and antimicrobial properties.[6] Because of its resilience, the species is also used in ecological restoration projects and desertification control programs. It can survive in degraded environments and gradually improve soil stability and ecological balance. Therefore, Capparis spinosa is both ecologically and economically significant.

Capparis spinosa L. is a highly adaptable xerophytic plant with significant ecological, economic, and medicinal importance. Its ability to survive in harsh environmental conditions is due to a combination of morphological, physiological, and reproductive adaptations. The species plays a vital role in maintaining ecosystem stability in arid and semi-arid regions. Further research on its ecological functions and cultivation potential can contribute to environmental conservation and sustainable agricultural development..

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