

Quinoa - *Chenopodium quinoa* Willd

A Drought-Resilient Crop of WaterMellon Project

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History and origin

- **Quinoa** is an ancient plant native to the Andean region of South America, particularly in countries like Bolivia, Peru, and Ecuador, where it has been cultivated for thousands of years.
- It is a **summer crop** with a relatively **short growth cycle**, highly adaptable to different environmental conditions, tolerant to drought and salinity, and often used in **crop rotations** with cereals and legumes.
- **Quinoa** is a highly nutritious food, naturally gluten-free, rich in protein (about 14 g/100 g), dietary fiber (7 g/100 g), essential minerals (such as iron, magnesium, and zinc), and vitamins (especially B vitamins and vitamin E). It is widely recognized as a health-promoting **superfood**.



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Morphological Characteristics

- **Quinoa growth:** Annual dicotyledonous plant with an erect growth habit, belonging to the *Amaranthaceae* family.
- **Plant height:** Typically ranges from 100 to 200 cm, depending on the variety and growing conditions.
- **Root system:** Well-developed taproot with extensive lateral branching, providing effective water uptake under drought stress.
- **Stem:** Erect, angular, often ribbed, with internodes that may exhibit pigmentation (green, red, or purple).
- **Leaves:** Broad, lance-shaped to triangular; green in color but can show red or purple hues, especially in high light or nutrient-deficient conditions.
- **Inflorescence:** Terminal panicle, varying in shape and density depending on genotype; composed of numerous hermaphroditic flowers.
- **Flowers:** Small, lacking true petals, predominantly self-pollinating, though partial cross-pollination can occur.
- **Seeds:** Achenes, 1.5–2.6 mm in diameter; seed coat color varies by cultivar (white, red, black)
- **Seed weight:** 1000-seed weight ranges from 2 to 3 grams, depending on the variety.
- **Life cycle:** About 90 to 150 days from sowing to harvest, depending on altitude, temperature, soil type, and variety.
- **Photosynthesis:** Quinoa is a C3 plant.





Climate and Soil Requirements

- **Preferred ecosystem:** Grows in highland, semi-arid environments with high solar radiation. Full sun exposure is essential for optimal vegetative and reproductive development.
- **Temperature:** Optimal growth occurs between 15°C and 25°C. Sowing should be carried out in spring, once soil temperatures reach at least 10–12°C and the risk of late frost has passed.
- **Rainfall:** Requires 300–800 mm of annual precipitation. Although drought-tolerant, adequate soil moisture is critical during germination, flowering and seed filling stages.
- **Salinity:** Grows in a wide range of soils, including saline and nutrient-poor substrates, but performs best in well-drained, finely textured soils. Proper seedbed preparation ensures uniform germination and emergence.



Agricultural Practices

- **Seed selection:** Quinoa is available in a wide range of cultivars, each exhibiting unique agronomic traits, stress tolerances, and end-use qualities.
- **Sowing seed:** Quinoa seeds are usually sown directly at a shallow depth of 1–2 cm to ensure good soil contact, as their small size. Precision seeders help achieve uniform spacing, with a seeding rate of 8–15 kg/ha mechanically. Germination takes 4–7 days under suitable moisture and temperature.
- **Fertilization:** Quinoa has moderate nutrient needs and benefits from balanced fertilization. Typically, 40–90 kg/ha of nitrogen is applied in split doses at sowing and early growth.
- **Irrigation:** Quinoa is a drought-tolerant crop, but to maximize yield, it requires regular irrigation during key growth stages. The most critical periods are flowering and seed development. Moderate and well-distributed watering supports good productivity and improves the quality of the harvest.
- **Planting time:** Typically sown from late winter to early spring (March–April) in temperate climates.
- **Weed control:** Weed competition is critical especially during the first 4–6 weeks after emergence. Mechanical cultivation and manual weeding are standard practices. Weed control is complicated by the similarity of quinoa to other botanical species within the *Chenopodium spp.* genus. Moreover, there are currently no herbicides authorized for use on quinoa.
- **Harvesting:** Quinoa is harvested when its inflorescences change color and seeds are dry and firm, with moisture below 14%. Plants are cut and threshed mechanically or manually (on a small scale). After harvest, the saponin-rich seed coats must be removed before consumption; this process can be carried out either mechanically or by washing.
- **Yield:** Quinoa grain yield ranges from 1.0 to 2.5 tons per hectare under standard conditions.



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World production and Market Value

- **Total cultivated area:** Quinoa is cultivated globally on approximately 180,000 hectares, with most of the production concentrated in South America, especially Peru and Bolivia. Cultivation is expanding in North America, Europe, Asia, and Africa.
- **Retail prices:** Retail quinoa prices vary by country and quality. In Europe and North America, prices typically range from USD 5 to 13 per kilogram for high-quality quinoa grain and quinoa flour.



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Use of the Quinoa



- **Human food:** Quinoa is widely consumed around the world due to its high nutritional value, being rich in proteins, essential amino acids, vitamins, and minerals. It is commonly used in a variety of dishes, including salads, soups, porridges, and snacks. Quinoa flour has gained popularity as a gluten-free alternative in the production of bread, pasta, baked goods, and breakfast cereals, catering especially to people with gluten intolerance or celiac disease. Its versatility and health benefits have contributed to its increasing incorporation into diverse culinary traditions.
- **Market preference:** Among the different quinoa varieties, those with white seeds are generally more appreciated by the market. The white-seeded quinoa is preferred due to its milder flavor and lighter color, which makes it more versatile for food processing and consumer appeal. This preference influences cultivation choices, seed selection, and breeding programs aimed at improving yield and quality traits in white quinoa varieties to meet consumer demand.

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