

White Lupin

Lupinus albus L., Fabaceae

A drought- and saline-resilient crop of WaterMellon project

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History and origin

- *Lupinus mutabilis* Sweet is native to the Andean regions of Peru, Bolivia, and Ecuador. Vernacular names include tarwi (pronounced tarhui), chocho, altramuz, Andean lupin, South American lupin, Peruvian field lupin, and pearl lupin. Its wider use has been limited by its bitter taste due to its alkaloid content, which consists of heat-stable toxins; cooking alone does not remove the alkaloids. Flower colour is usually violet, yellow and sometimes whitish.
- *Lupinus albus* (white lupin) is thought to have originated in southeastern Europe and western Asia and is widely used for human food and feed.



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Morphological Characteristics

- **Life cycle:** Approx. 150 to 300 days from sowing to harvest, depending on edaphoclimatic conditions and variety.
- **Photosynthesis:** Lupin is a C3 plant.
- **Growth:** Annual spring or winter crop with an erect growth habit, belonging to the Fabaceae family.
- **Height:** Can reach up to 1.2 m, depending on the variety and growing conditions.
- **Root system:** Well-developed taproot with extensive lateral branching. The secondary roots develop nodules, formed through symbiosis with *Bradyrhizobium* spp., facilitating biological nitrogen fixation.
- **Stem:** Erect, cylindrical, and herbaceous; the color of the stem varies from green to brown depending on the maturity state.
- **Leaves:** Palmately arranged, composed of 5 to 12 leaflets radiating from a central point. The leaflets are narrow-lanceolate to obovate, and their surfaces may be glabrous or hairy.
- **Inflorescence:** Terminal raceme, often dense and elongated.
- **Flowers:** Papilionaceous (typical of the Fabaceae family), with five petals.
- **Pods and seeds:** Individual plants produce several orders of inflorescences and branches, resulting in clusters of long, oblong hairy pods. Each cluster bears 3-7 pods, and each pod contains 3-10 seeds, depending on the variety. Seeds are lenticular to flattened-oval in shape, with a white seed coat.
- **Seed:** 1 kg ranges from 3,500 to 5,000 seeds, depending on the variety.



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Climate and Soil Requirements

- **Preferred ecosystem:** Grows well in mild Mediterranean or temperate climates and prefers full sun.
- **Temperature:** Grows well between 8°C and 25°C. Lupin is frost sensitive except at the early stages of growth. Sowing should be carried out in spring (March – April) in Central Europe and in autumn (October – November) in Mediterranean regions.
- **Rainfall:** Requires 400–600 mm of annual precipitation. Lupin is drought-tolerant and quite sensitive to waterlogging, mainly due to root diseases.
- **Soil pH:** The suitable soil pH range is 5.5–7.5; strongly alkaline soils (pH > 8) should be avoided.

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Agricultural practices

- **Seed selection:** A wide range of lupin varieties have been registered in the European catalogue (approx. 30). In Mediterranean regions, drought-tolerant varieties should be selected, whereas in Central and Northern Europe, varieties with better performance under cooler conditions should be preferred.
- **Sowing:** seeds are usually sown directly at a shallow depth of 2.5 – 5 cm depending on soil type. The seeding rate ranges from 90 - 100 kg/ha, and germination occurs within 5 - 10 days.
- **Fertilization:** Lupin has low nitrogen requirements (10-20 kg N/ha) due to its nitrogen-fixing ability. Phosphorus and potassium requirements are moderate, with 30–60 kg P/ha and 40–80 kg K/ha usually applied at sowing.
- **Planting time:** It is sown in autumn in temperate climates (Mediterranean region) and in spring in colder climates (Central and Northern Europe).
- **Weed control:** Lupin is vulnerable to early competition, especially during the first weeks after emergence. Early weed management is recommended to minimize yield losses.
- **Harvesting:** It can be harvested mechanically or manually. The crop is ready for harvest when grain moisture is 12 – 16 %, and the seeds rattle inside the pods.
- **Yield:** Lupin seed yields in the Mediterranean region typically range between 1.8 and 3.0 t/ha.



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World Production and Market Value

- **Total cultivated area:** In southern Europe, the total cultivated area exceeds 11,000 ha, with approximately 5,000 ha in Italy, 3,600 ha in France, and 3,050 ha in Spain. In southern Greece, lupin is a traditional crop grown in low-fertility agricultural areas.
- **Farm-gate price:** The selling price at the farm gate usually ranges from 0.23 to 0.32 EUR/kg.





Uses of Lupin

- **Food and Livestock industry**

- The white lupin seeds contain more than 40% protein and are consumed as a snack food and/or for gluten-free flours, pasta, and other food products.
- Due to its high protein content and good digestibility, lupin is an excellent feed for livestock, especially for ruminants.

- **Environmental & Industrial Uses**

- Lupin can be used as a winter cover crop and to enrich soils with nitrogen through biological nitrogen fixation. It can be easily integrated into crop rotation systems with cereals and tuber crops, improving soil structure and overall agroecosystem health.
- It is also suitable for phytoremediation of contaminated soils.
- In addition, lupin has industrial applications, including protein isolation and the production of bioplastics from seed meal.



Lupin is a high-protein, drought-tolerant legume with low input requirements and multiple food, feed, environmental, and industrial uses. Thanks to its nitrogen-fixing ability, adaptability to Mediterranean and temperate climates, and role in sustainable farming systems, it represents a promising crop for resilient and multifunctional agriculture.

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