

Quinoa is a high-quality protein grain that originates in the Andean region and has recently become a global commodity. It can be processed for food or sold as a grain. It contains high-quality protein, with all the essential amino acids, is gluten free and it has a low glycaemic index. It has therefore been promoted widely as a superfood. It is well adapted to grow in extreme environmental conditions, in drought, frost, marginal and saline soils. This makes it a good potential crop for building resilience to climate change in addition to providing a plant-based source of protein.

## Crop Description

Quinoa has highly nutritious small seeds. The cultivars in Europe vary in height, but generally grow to 1-1.5 m.

- **Life cycle:** 4-5 months
- **Protein content:** 14-18%  
(of which 73% can be absorbed by humans)
- **Global yields:** 847 kg/ha [1]

## Market Potential

The quinoa market has expanded rapidly as demand in Europe has soared. Quinoa is now growing in countries outside of the Andean region, such as Spain, France and China. In Denmark, production increased from 6 ha in 2016 to 159 ha in 2018 [2]. The demand for quinoa is expected to increase due to changes in diet habits, while the interest in meat alternatives and plant-based proteins further inspires its consumption. Quinoa has been widely accepted by consumers and can be included in gluten-free and low glycaemic diets [2, 3]. In Denmark, 80% of vegetarian consumers would like quinoa to be included in more plant based foods [4].

*“Sold as grain, flour & flakes and included as an ingredient in new food products.”*



# Challenges

Quinoa is a new crop, therefore approved methods for plant protection and processing facilities to remove saponin have yet to be developed.

**Major pests and diseases:** Downy mildew (*Peronospora quinoae*) and aphids are a problem in Denmark. The main weeds are 'goosefoot' *Chenopodium album* (hard to distinguish from quinoa) and 'black bindweed' *Fallopia convolvulus*.

# Recommendations

**Land preparation/rotation:** Include quinoa in rotation to prevent soil borne diseases. False seedbeds can help to reduce weed competition.

**Soil types:** Soil must be well structured and drained, while retaining enough moisture for germination.

**Seeds:** Select varieties with low saponin content. Breeding efforts obtained varieties suited to the daylength and seasons in Denmark [5].

**Sowing dates:** *There was no difference in yield between different sowing dates tested, but early sowing (usually April) is recommended so quinoa can be harvested before the end of summer.*

**Sowing depth and distances:** Sow at 0.5-1 cm depth with 12-50 cm distance between rows, in order to allow for row cleaning [2].

**Fertilization:** Quinoa requires 80-120 kg N/ha [2] and responds to higher levels. *Some cultivars (Titicaca) are more responsive to higher N levels.*

**Harvesting:** Mid-August to mid-September depending on the growing variety. Avoid harvesting in the autumn when conditions are cold and humid, this can affect seed quality and require drying [5]. Harvest when seeds are mature and the plant is brown and dry.

**Threshing:** For bitter varieties, with high saponin content, the hull should be removed, and the seeds should be washed to be consumed.

# Trial results

Table 1. Data from University of Copenhagen field trials under a low input production system in Taastrup, Denmark.

Cultivar	Yield (kg/ha)	Protein (%)	TKV (g)	Notes
Titicaca	1093	16.1	2.95	Bitter Early maturing
Puno	833	17.6	2.05	Bitter White grain
Jessie	691	15.9	2.23	Sweet White grain
Riobamba	688	15.7	1.98	Sweet Late maturing
Vikinga	594	12.3	2.10	Sweet
Atlas	434	14.7	2.44	Sweet Late maturing
Pasto	337	15.6	2.09	Sweet Late maturing

Note: bitter=high saponin level, sweet=low saponin level.

The table shows average yields over 5 years of trials, however maximum yields were 2.5 t/ha. Similar KU trials had yields of 1.5-2 t/ha in Livø, DK [6].

# Summary of Benefits

- Existing cultivars are well adapted to Danish conditions
- High quality protein in grains
- Existing and expanding markets

# References

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**Note:** Results of Protein2Food trials at Copenhagen University are in orange. Trials were run from 2015-2019 in Taastrup under a low-input production system.



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