

Almonds



Prunus amygdalus



CONTENTS

1	Plant background
2	Botanical description
3	Varieties
4	Climate conditions
5	Leading apple growing countries
6	Growing season
7	Rootstock
8	Soil
9	Nursery
10	Tree treatments
11	Harvest
12	Tree spacing
13	Irrigation
14	Critical stages for water stress
15	Irrigation management with water shortage
16	Recommended irrigation method
17	Fertilization application
18	Yields
19	Main diseases
20	Main pests
21	Frost protection
22	Recommended irrigation equipment

1 Plant background

Stone fruit, from the Rosaceae family, closest to the peach. Originates from the Middle East, where conditions are dry and hot. Almonds spread throughout the entire Mediterranean Region and afterwards to the USA (California), Northern Africa, Turkey, Iran, Australia and South Africa. The almond is sensitive to wet conditions, and is therefore not grown in wet climates.

The almond is popular in the market due to its dietary properties, such as: low level of saturated fat, and high Vitamin E level, as well as a high level of unsaturated fat.

2 Botanical description

Trees grow to a height 4.0-6.0m with a diameter of 3-4m. The almond is hermaphrodite, but male and female blossoms are not in accord, so insects are necessary for pollination. Like peaches, the blossoms form around the vegetative buds. They are located on spurs that live 3-4 years, though some blossoms also form on new branches. As opposed to other stone fruit, the pulp does not continue to grow in the third and last period. At the end of the growing season, the pulp dries and opens, to expose the seed covering, which reaches its final size after about 100 days. The almond tree can live a long time, but the lifetime of a commercial orchard is 30-40 years. Blossoming and fruit-set begin at two years, full fertility at four years, and maximum yield is attained at 7-9 years. Blossoms are light pink. Blossoming occurs in January-March, with fruit ripening in July-August, 5-6 months after blossoming in the northern hemisphere, and in the corresponding months in the southern hemisphere.



Almonds

3 Varieties

There are two main varieties: hard shell – Buttei, Texas, and soft shell – Thompson, Carmel, Rudy. Regular shell varieties: California, Mission Neplus,

Greek, Hanatziv, Um-el-Fahem, Marcona, Be’eri. Non-pareil is the main variety, comprising 50% of global yields. There are sweet almond and bitter almond varieties.

4 Crop climate conditions

Optimum is a dry warm climate – sub-tropical. Almonds can be grown without irrigation, and are more resistant to dry conditions than other deciduous trees, but yields will be low. It is accepted policy to add supplementary irrigation, where annual rainfall is less than 500 mm. Almonds do not like excess humidity. Its growing range is

quite wide, between 30° – 45° laterals. Almonds require less cold units than other deciduous trees, but vary from one variety to the next. Most varieties require 300-500 cold units. Cold conditions are a serious problem for almonds, which blossom in early spring. Blossoms suffer damage at -2°C, and vegetative buds at -4°C to -6°C.

5 Leading almonds growing countries (2003)

Country	Planted area (ha)	Seed Yield (ton/ha)	Total Seed Yield (tons)
Spain	681,000	0.30	197,300
USA	214,000	3.50	740,400
Tunisia	202,000	0.90	185,000
Morocco	131,000	0.54	79,800
Iran	115,000	0.91	105,000
Italy	86,000	1.10	91,400
Libya	60,000	0.50	31,000
Algeria	40,000	0.80	32,000
Greece	40,000	1.00	40,000
Portugal	38,000	0.70	26,000

6 Growing season

Buds open at the end of winter - beginning of spring, the flower buds open before the leaf buds. Blossoming time differs slightly according to variety, and lasts about two weeks. Fruit develops from mid-July to August. At the

end of this period, the green shell opens. The inner shell completes its development 100 days after blossoming. Harvest time is from the end of August to mid-September. The leaves fall off in October – November and the tree goes into dormancy.

7 Rootstock

Accepted rootstocks are seedlings: almond, bitter

almond, peach-almond hybrid, plum, mariana; in California the use mostly peach seedlings.

8 Soil

Soil – almonds grow in all types of soil, including chalky and shallow soils. The optimal pH is 7.0-8.5.





Almonds

9 Nursery

Like with peaches, it is common to graft saplings in the nursery. Planting is at the end of the dormant season, before blossoming. Saplings are planted with roots exposed.

10 Tree treatments

Tree treatments –standard pruning is vase shaped, to enable better light and radiation penetration. It is not necessary to thin out blossoms. All the blossoms reach fruit-set and most are collected. It is normally recommended not to cultivate the soil. Weeds along the rows should be treated with herbicides, while between the rows they should be mown. Alternatively, it is possible to grow and intermediate crop in this area, mainly legumes.

11 Harvest

After the outer shell of all the fruit has opened. It is acceptable to use a tree shaker.

12 Tree spacing

In the past, orchards were not irrigated, and the number of trees per hectares was low – 140 trees/ha, with 7-10 m between rows. Pollinating varieties were planted every fourth row. Presently, row spacing is every 4-6 m, with ~400 trees/ha. There is also an innovative approach where trees are planted every 2-4 meters due to the short lifetime.

13 Irrigation

Irrigation – in the northern hemisphere: irrigation coefficients – Kc

	Spring		Summer			Autumn
	April	May	June	July	August	October
Kc coefficient	0.20-0.50	0.25-0.55	0.45-0.75	0.70-0.90	0.60-0.80	0.20

General water requirements: 800 mm per season.

14 Critical stages for water stress in the soil in apple orchards

The development stage of the kernel and the filling-out stage of the kernel.





Almonds

15 Irrigation management with water shortages in apple orchards – deficit irrigation

Where the water supply is limited, minimum waste of water is essential, so trees should be irrigated only to the point where they are sensitive to stress. However, if this quantity of water is insufficient for the tree's needs, it is necessary to find the right stage, where water reduction will do the least harm. Deficit irrigation can influence not only the current yield, but also the following season's yield, therefore, it is necessary to find the most suitable irrigation strategy.

It is possible to plan irrigation in orchards for several years, and the plan can be flexible according to the prevailing conditions. In almonds, it is important to apply full irrigation in the early spring, during kernel filling, and it is also important for the yields in the long run.

In early almond varieties and spring varieties, it is possible to seriously reduce water quantities to trees from mid-June for two months. Later varieties can be resistant to stress during the two months preceding harvesting. This method reduces the kernel weight by about 10%, but results in considerable reduction in shell splitting. Renewing irrigation two weeks before harvesting improves shell splitting.

With drip-irrigated almonds or grown in shallow soil, the irrigation regime after harvesting is critical for the following season. Reduced irrigation after harvesting, results in a reduction in the number of blossoms and in fruit-set in the following year, therefore farmers must retain reserve water for irrigating after harvesting. This must be applied immediately after harvesting.

In deep soil or where sprinklers are used for irrigation, it is less important to irrigate immediately after harvesting, and this can be delayed.

Early falling off of leaves is a sign of insufficient irrigation. However, irrigating when leaves drop off after harvesting can cause leaves to renew growth, which is not desirable.

The approach proposed here improves the tree's moisture conditions at the critical stage for the following season's blossom buds. Blossoming at the end of autumn can reduce the following year's yield. This happens when the leaves renew growth in the autumn, when the climate is cold in October, then turns warm in November. Limiting irrigation during late autumn reduces unwanted blossoming.

16 Recommended irrigation method

Drip irrigation is recommended – in older orchards with traditional spacing, 2 laterals per row; in young orchards – 1-2 laterals per row depending on the soil type. The recommended distance between drippers is 0.5m.

Discharge rate should be 1.6-2.3 l/h. Irrigation frequency will be according to soil type, every 2-3 days. The accepted equipment in mountainous regions is Ram, and in level terrain Tiran or Ram, and Uniram for subsurface drip.

17 Fertilization application

During soil preparation: 400-600kg/ha P₂O₅ and 600-700 kg/ha K₂O, depending on soil test results. 2kg boron should be added as needed.

During years 1, 2 & 3 30, 60, & 90 grams N per tree accordingly.

Annual fertilizer consumption for fruit bearing trees

N – kg/ha	P ₂ O ₅ – l/ha	K ₂ O – kg/ha
250-300	60	300-400

18 Yields

Average yields are 20 tons almonds; 9 tons of shelled

kernels/tree. The annual international yield is 1 million tons. In Spain almonds are also used in the wood industry.

19 Main diseases

Rust on stone fruit (*tranzchelia discolor*), *cercospora circumscissa*, *polystigma ochraceum*, *agrobacterium tumefaciens*, *verticilium* spp., *deplodea* sp., silver leaf (*chondrostereum purpureum*), *pytophthora*, nematodes, brown rot (*monilinia* sp.), oak rot (*amillaria*).

20 Main pests

Navel orange worm (*amyeloides transitella*), twig borer (*anarsia lineatella*), mites, *eurytoma amygdali*, *capnodis tenebonis*, *cerambyx dux*, *eccoptogaster amygdaly*, *lyonetia clerkella*, *lymantria destituta*, *meloidogyne* spp, *brachycaudus amygdaliana*





Almonds

21 Frost protection

Due to early budding, particularly blossoms, almond trees could easily be harmed by early frost, or even by

later, seasonal frost. Therefore, in light of these data, it is recommended that a frost protection system be installed. The recommended system is the use of SuperNet® micro-sprinklers for every tree.

22 Recommended irrigation equipment for almonds

Drip Irrigation

Netafim produces and markets a very broad range of products, with the aim of providing solutions for every irrigation need. Therefore, for every region, soil type, farmers' demands, etc., we are capable of providing a solution tailored to these needs.

Following are the general recommendations for three types of equipment, which, according to our experience, can provide the most suitable solutions for crop and grower demands. However, these are not the only possible solutions.

UniRam® compensated drippers, with a self-cleaning mechanism, ensure identical applications of water and fertilizers, regardless of inlet pressure (as long as the pressure is within the recommended limits) and/or topography throughout the irrigation cycle. In addition, this equipment has the following properties: (a) anti-siphon mechanism – to prevent dirt being sucked into the dripperline from outside when the irrigation cycle is completed, which could create a vacuum in the dripperline due to the steep topography, and (b) non-leakage (CNL) mechanism that prevent the dripperline from emptying out at the end of the irrigation cycle, which means that the dripperlines are ready and waiting for the next irrigation cycle, ensuring uniform opening – ideal for short and frequent irrigation applications.

UniRam® equipment can be used at flow rates of 1.0, 1.6, 2.3 & 3.5 l/h. Spacing between drippers is between 0.5 – 0.75 cm. Flow rate and spacing between drippers will be determined according to the soil type and the total hours available for irrigation.

UniRam equipment is produced in two wall thicknesses: 1.2 and 1.0 mm. The wall thickness determines the maximum work pressure. These dripperlines, when laid out / rewound and maintained according to instructions, will ensure many seasons of precise and reliable operation.

Ram® compensated drippers, with a self-cleaning mechanism, to ensure that all plants in the field will receive identical applications of water and fertilizers,

regardless of inlet pressure (as long as the pressure is within the recommended limits) and/or topography throughout the irrigation cycle.

Ram® equipment can be used at flow rates of 1.2, 1.6, 2.3 & 3.5 l/h. Spacing between drippers is between 0.5 – 0.75 cm. Flow rate and spacing between drippers will be determined according to the soil type and the total hours available for irrigation.

Ram® equipment is produced in three wall thicknesses: 1.2, 1.0 and 0.9 mm. The wall thickness determines the maximum work pressure. These dripperlines, when laid out / rewound and maintained according to instructions, will ensure many seasons of proper operation.

P.C.J.-C.N.L. online drippers are compact anti-drain, pressure-compensated drippers that ensure that the same quantity of water and fertilizer will reach each tree, regardless of inlet pressure (as long as the pressure is within the recommended limits) and/or topography throughout the irrigation cycle.

P.C.J.-C.N.L. online drippers equipment can be used at flow rates of 1.2, 2.0, 3.0, 4.0 & 8.0 l/h. Drippers can be inserted on the polyethylene pipes at the desired spacing. Flow rate and spacing between drippers will be determined according to the soil type and the total hours available for irrigation. It is possible to insert a few drippers when the trees are young, and add drippers in accordance with the trees' growth rate.

The non-leakage characteristic prevents water from emptying out of the dripperline at the end of the irrigation cycle, leaving it full of water and ready for uniform opening and to immediately begin a new irrigation cycle, making it ideal for short and frequent irrigation cycles.

In addition to using drip irrigation, another option is the use of micro-sprinkler irrigation in deciduous orchards.

Micro-sprinkler Irrigation

For Irrigation and Fertigation- Flow compensated sprinklers

- **SuperNet®** – one sprinkler per tree from 20 to 110 L/H with wetted diameter of 1.5m up to 8.0m. It is also available with an upside-down option with insect proof





Almonds

22 Recommended irrigation equipment for almonds *(continued)*

- **SuperNet®** – provides full coverage and full overlap of 2X2 up to 6X6 upright or upside-down. Same flow rates and swivels available.
- **PowerNet FC** for full overlap irrigation with 9-15° and 24° trajectory and 180l/H up to 340L/H

For Irrigation and Fertigation with Micro sprinklers

- **GyroNet®** - one sprinkler per tree from 27 to 300 L/H with wetted diameter of 1.5m up to 8.0m. It is also available in an upside-down option with insect proof swivels.
- **GyroNet®** - full coverage and full overlap of 2X2 up to 6X6 upright or upside-down. Same flow rates and swivels available.
- **GyroNet® Turbo** - full coverage and full overlap 200-250-300 L/h of 4X4 up to 7X7.
- **PowerNet®** for full overlap irrigation with 9-15° and 24° trajectory and 180L/H up to 460L/H

For Frost protection, coloring and cooling

- **SuperNet® LR** and **GS** for full above canopy frost protection and cooling in marginal and irregular topography.
- **PowerNet® FC** for full above canopy frost protection and cooling in marginal and irregular topography.
- **GyroNet®** and **GyroNet® Turbo** for above canopy frost protection and cooling with very low pressures.
- **SuperNet® UD** (Upside-down) for under canopy frost protection in marginal and irregular topography.
- **GyroNet® UD** for under canopy frost protection and cooling with low pressures.
- **Coolnet®** for evaporative cooling under canopy, especially with marginal water.

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