

Citrus

Irrigation & Fertigation Guidelines



/ Introduction

Citrus is one of the world's most widely grown fruit crops, and is produced in over 140 countries. The most common citrus crops are oranges, lemons, tangerines, and grapefruits, all of which are primarily traded and consumed as fresh fruit, juice or concentrate. Irrigation and fertigation are essential to ensure good citrus tree development and quality, high and stable yield.

Drip irrigation enables optimal and uniform soil moisture with outstanding aeration, and directly distributes water and nutrients to the crop's root zone. By increasing yields while lowering nutrient and water use, drip is the most cost-efficient irrigation solution for growing citrus trees.

/ Drip Irrigation and Fertigation Benefits

- **Higher yields** – Intensive cultivation with drip irrigation and fertigation significantly increases yield.
- **Better size and quality** – Precise drip and fertigation capabilities improve fruit size and quality.
- **Significant water and nutrient savings** – An efficient irrigation system leads to water savings and better water use efficiency (WUE) and nutrient use efficiency (NUE) (i.e. mm/ton).
- **Crop protection** – Drip offers an innovative and cost-effective method for applying a wide range of substances that protect the crop in an environmentally safe way.

/ Irrigation of Citrus Orchards

General guidelines

Below are basic guidelines and recommendations for the irrigation and fertigation of citrus orchards with an estimated yield of 40-80 tons/ha. We recommend you adapt your plan according to specific local conditions relating to soil type, climate, variety, rootstock, planting patterns, and yield targets.

Irrigation recommendations

- Place the dripline 30cm from the trunk.
- Most roots of modern citrus trees are shallow, while the roots of mature trees may be deep.
- Micro sprinkler irrigation requires a 20% additional water dose compared to drip.
- Recommendations are based on zero rainfall and for fully grown trees. If trees are already productive but the canopy is not fully developed, reduce irrigation by 10-20% relative to tree size.
- Precipitation factors
 - An effective rain event is >10mm.
 - Rain efficiency should be calculated at a 60% rate for mature orchards and a 40% rate for young orchards.
 - After a significant rain event, resume irrigation either when the topsoil layer starts drying or according to the soil sensor indication. In the case of light-sandy soil or hot climate, resume irrigation within 1-2 days. In the case of medium-heavy soil or cooler climate, resume irrigation within 2-4 days.
- Convert mm/day or m³/ha/day recommendations to hours/shift/day by using the following formula:

$$\frac{\text{Dripper flowrate (l/h)} \times \text{number of driplines per row}}{\text{Dripper spacing (m)} \times \text{dripline spacing (m)}} = \text{Application rate (mm/h)}$$

Example

- Recommended irrigation dose: 5mm/day = 50m³/ha/day
- Driller spacing: 0.5m
- Dripline spacing: 5m (usually 2 laterals/crop rows are used, so typical lateral spacing is 2.5m)
- Driller flow rate: 1.0 l/h

$$\frac{1.0}{0.5 \times 2.5} = \frac{0.8 \text{ mm}}{\text{hour}} = 8 \text{ m}^3/\text{Ha}/\text{hour} \quad \frac{5 \text{ mm}/\text{day}}{0.8 \text{ mm}/\text{hour}} = 6.25 \text{ hours}/\text{shift}/\text{day}$$

/ Crop Coefficient Per Growth Stage

Early Mandarin

Stage	Flowering	Fruit set	Fruit growth	Ripening	Post-harvest
Graphic presentation					
Duration (days)	30	45	90-120	60-120	60-120
Kc	0.3	0.4	0.55-1	0.85	0.15-0.4
Depletion threshold (%)	10	10	15	25	30

- Difference in days is based on time of harvest
- When fruit is too small, there is a need to irrigate more and vice versa

Late Mandarin

Stage	Flowering	Fruit set	Fruit growth	Ripening	Post-harvest
Graphic presentation					
Duration (days)	30	45	120-180	60-120	0-120
Kc	0.3	0.4	0.55-0.9	0.55	0.15-0.4
Depletion threshold (%)	10	10	15	25	30

- Difference in days is based on time of harvest
- When fruit is too small, there is a need to irrigate more and vice versa

/ Fertigation of Mature Orchards

Fertigation recommendations

- Assume low-to-medium P and K levels in the soil.
- Apply fertilizer in every irrigation to spread the overall amount across expected events throughout the relevant period.
- Start fertigation only once the system is fully pressurized.
- After fertilizer injection, irrigate with clean water for at least 30 minutes.
- If fertigation in every irrigation is unfeasible, fertigate at least once a week.
- In the case of rain, skip irrigation but not fertigation, applying a high concentration of fertilizer and a small water volume.
- For early harvested plots, stop fertigating N 2-3 months before harvest and complete the annual amount after harvest.

Citrus Fertigation Recommendations, According to Leaf Analysis* (kg/ha)

Element	Higher than advisable	Within advisable range	Lower than advisable
Nitrogen (N)	150	250	300
Phosphate (P ₂ O ₅)	0	30	60
Potassium (K ₂ O)	0	180	300

* In the absence of leaf analysis, follow recommendations for the advisable range

/ Irrigation and Fertigation of Young Orchards

General guidelines

- Recommendations are based on zero rainfall in mild climates such as Mediterranean temperatures.
- Apply water near the trunk and within reach of the young root zone. The fertigation dose is the amount applied near the root zone.
- Irrigation units are in liters per tree per day (l/t/d).
- Fertigation units are in grams per tree per day (g/t/d).
- Place all drippers directly above the root zone, and ensure that drops do not slide along the drip laterals and miss their target.
- The root zone diameter is roughly parallel to the canopy diameter, so drippers that are not below the canopy do not reach the effective part of the root zone.
- Install cap drippers between the trees to avoid water and fertilizer waste during the first few years of fertigation. Use dedicated caps for UniRam™, and continue opening them as the tree develops.

Example

- First-year orchard has four x 1.0 l/h drippers near the root zone
- Recommended irrigation is 4 l/t/d
- 1 dripper per tree x 1.0 l/h = 1 l/h/t dripper flow rate

$$\frac{4.0 \text{ l/t}}{1 \text{ l/h}} = 4 \text{ hours/tree/day}$$

- Irrigate for 4 hours/shift/day.



Irrigation Table – Young Orchard (years 1-4)

Liters / Tree / Day

	Fall	Early fall	Late summer	Summer	Early summer	Late spring	Spring	Emitters per tree
Year 1	1	2	3	4	5	5	5	1-2
Year 2	10	10	10	12	15	15	15	3-4
Year 3	15	20	22	25	25	25	20	All emitters open
Year 4	20	25	30	40	40	40	30	All emitters open

Fertigation Table – Young Orchard (years 1-4)

Grams / Tree / Day

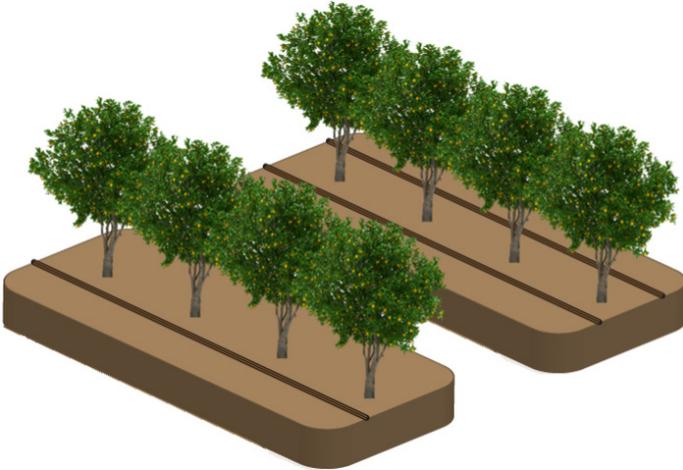
	N	K ₂ O	Do not exceed (kg/ha)	P ₂ O	Do not exceed (kg/ha)	Numbers of drippers
Year 1	0.4	0.4	40	0.2	20	1-2
Year 2	0.8	0.8	80	0.3	30	3-4
Year 3	1.2	1.2	120	0.4	40	All drippers
Year 4	1.6	1.6	160	0.6	60	All drippers



/ Drip Irrigation Configurations

On-surface

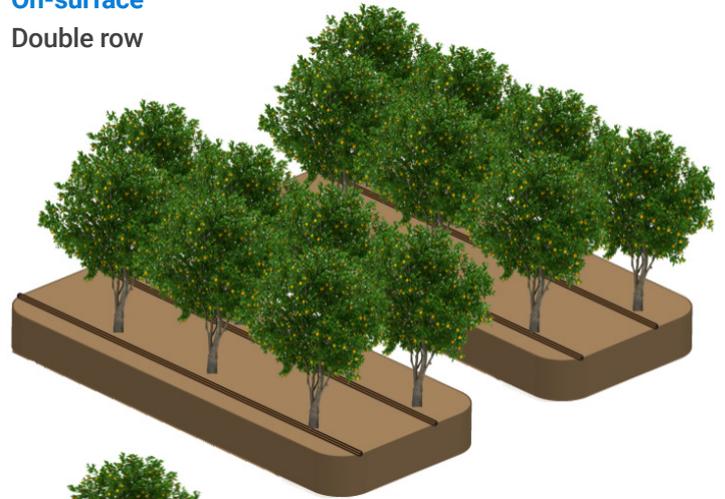
One or two laterals per tree row (depending on soil type)



Plant spacing: 2-4m
 Row spacing: 5-7m
 Ridge spacing: 5-7m
 Dripper spacing: 0.5 m
 UniRam™ / DripNet PC™ 1-2.3 L/H

On-surface

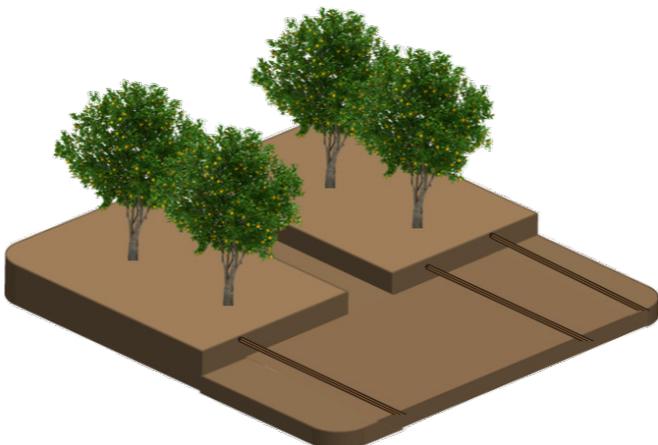
Double row



Plant spacing: 2m
 Row spacing: 2m
 Center ridge spacing: 6-7m
 Dripper spacing: 0.5 m
 UniRam™ / DripNet PC™ 1-2.3 L/H

Subsurface

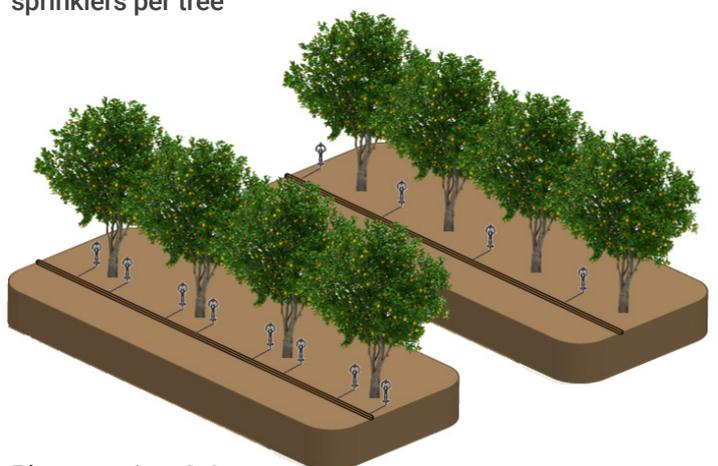
One or two laterals per tree row (depending on soil type)



Plant spacing: 2-4m
 Row spacing: 5-7m
 Ridge spacing: 5-7m
 Dripper spacing: 0.5 m
 UniRam™ XR/ DripNet PC™ XR 1-2.3 L/H

Micro sprinkler

One micro sprinkler between two trees, or two micro sprinklers per tree



Plant spacing: 2-4m
 Row spacing: 5-7m
 Ridge spacing: 5-7m
 Micro sprinkler spacing: 2-7m
 SuperNet™ / GyroNet™ 20-110 l/h



/ Netafim Irrigation Solutions

Multi-Seasonal – On-surface/Subsurface Drip Irrigation Solutions

UniRam™

Large PC dripper

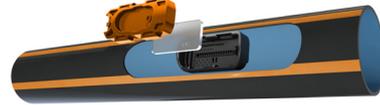
- Wall thickness: 1.0-1.2mm
- Flow rates: 1.0, 1.6, 2.3, 3.5 l/h



DripNet PC™

Compact PC dripper

- Wall thickness: 0.31-1.00mm
- Flow rates: 1.0, 1.6, 2.0, 3.8 l/h



Row spacing and configuration: 1-2 dripline for every row, 0.5m distance between drippers (based on soil structure and flow rate)

For SDI application use UniRam™ XR/ DripNet PC™ XR to prevent root intrusion and dripper blockage

Multi-Seasonal – Micro-Sprinkler Irrigation Solutions

Netafim micro-sprinklers for citrus include:

- Localized coverage of irrigated area
- Deflector - for a lower wetting diameter in the first years, and it can be broken, allowing for extended irrigation diameter.
- Pop-up swivel - a pop-up mechanism that opens only during irrigation
- EverSpin technology - upper bearing offers higher reliability & longevity – providing excellent clog resistance.
- High crop uniformity - thanks to the unique design of the flow regulation mechanism.
- Stream splitter - divided the stream to eliminate the water on the trunk.

Multi-Seasonal – Micro-Sprinkler Irrigation Solutions

SuperNet™

PC micro sprinkler

- Long lateral
- Flow rates: 20-110 l/h



GyroNet™

Non-PC micro sprinkler

- Broad applications
- Flow rates: 27-300 l/h



Pulsar™

GyroNet frost mitigation system

- Localized coverage of irrigated area
- Cutting-edge water-saving technology
- Advanced flow-regulation devices
- Flow rates: 8-35 l/h



Got more questions?
Consult our global citrus expert

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platform - GrowSphere

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