NETAFIM™
An Orbia business.

Coffee

Irrigation & Fertigation Guidelines

Introduction

Coffee growers worldwide are always striving to achieve rapid ROI and to enhance crop quality and yield. Modern intensive coffee plantation cultivation, meanwhile, is characterized by high-density planting and high production varieties with tolerance to diseases, while facing global climate change challenges.

Drip irrigation is a rapid-responding system that enables optimal and uniform soil moisture with outstanding aeration, while directly distributing water and nutrients to the crop's root zone. Drip increases yields while lowering nutrient and water usage, making it the most cost-efficient irrigation solution for growing coffee.

Drip Irrigation and Fertigation Benefits

- **Higher yields –** Intensive cultivation with drip irrigation and fertigation increases yield significantly.
- **Better quality –** Precise drip and fertigation capabilities improve crop quality.
- **Fast maturation and production –** Drip enables reaching full yield by the 2nd-to-3rd year of crop development.
- **Significant water and nutrient savings –** An efficient subsurface 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 to apply a wide range of products that can protect the crop in an environmentally-safe way.

Coffee Plantation Irrigation

General guidelines

Below are basic guidelines for irrigating coffee plantations at estimated yields of 2.5-4 tons/Ha of Arabica and 6-7 tons/Ha of Robusta in tropic or subtropic climates. Adapt your plan according to specific local conditions such as soil type, climate, planting density, and expected yield.

Irrigation recommendations

- Place the driplines about 30 cm from the trunk.
- Most of the roots of the coffee plant are located around the upper 40 cm area. As such, make sure the driplines are properly installed.
- Recommendations are based on zero rainfall and for fully grown trees. If the 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 >10 mm.
  - 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 a hot climate, resume irrigation within 1-2 days.
    - » In the case of medium-heavy soil or a cooler climate, resume irrigation within 2-4 days.

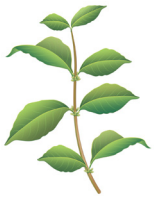
Crop coefficient per growth stage

Arabica

Growth stage	Pre-flowering	Flowering	Fruit set	Fruit growth	Fruit maturation	Harvest	Stress induction
Graphic presentation							
Duration (days)	45	30	15	60	90	75	50
Kc	0.6	0.65	0.7	0.75	0.8	0.8	0.4
Depletion threshold (%)	50	30	50	50	50	50	70
Irrigation Intervals (days)	1-3	1-3	1-3	1-3	1-3	1-3	

Irrigation intervals should be determined according to soil type.

Robusta

Post-harvest	Flowering	Fruit formation	Fruit expansion	Fruit growth	Fruit maturation + harvest	Post-harvest
Graphic presentation						
Duration (days)	30	45	45	90	120	30
Kc	0.8	0.85	0.9	0.95	1.0	0.4
Depletion threshold (%)	50	30	20	15	15	70
Irrigation Intervals (days)	1-3	1-3	1-3	1-3	1-3	1-3

Irrigation intervals should be determined according to soil type.

Irrigation calculations

Recommended irrigation dose calculation (quantity)

The recommended irrigation dose (= crop water requirements = ETc) is the amount of water a crop needs during its growth cycle to ensure proper development and yield.

The equation includes environmental and vegetative factors:

$$\text{ETo (mm/day)} \times \text{Kc} = \text{ETc (mm/day)}$$

- ETo = Evapotranspiration
- Kc = Crop factor

Example

- ETo = 4 mm/day
- Kc = 0.7

Recommended irrigation dose: 4 mm/day × 0.7 = 3 mm/day

Application rate calculations (quantity and time)

Convert mm/day or m^3/Ha/day recommended irrigation dose to hours/shift/day via the following formulas:

- Application rate calculation

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

- Irrigation cycle duration calculation

$$\frac{\text{Recommended irrigation dose (mm/day)}}{\text{Application rate (mm/h)}} = \text{hours/shift/day}$$

Example

- Recommended irrigation dose: 3 mm/day = 30 m^3/Ha/day
- Dripper flow rate: 1.6 l/h
- Number of driplines per row: 1
- Dripper spacing: 3.5 m
- Dripline spacing: 0.5 m

Application rate calculation:

$$\frac{1.6\ \text{(l/h)} \times 1}{0.5\ \text{m x}\ 3.5\ \text{m}} = 0.9\ \text{mm/h}$$

Irrigation cycle duration calculation:

$$\frac{3\ \text{mm/day}}{0.9\ \text{mm/h}} = 3.33\ \text{hours/shift/day}$$

Fertigation Recommendations

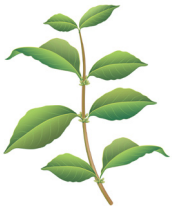
- Assume low-to-medium levels of phosphorus (P) and potassium (K) in the soil. Soil analysis for more accurate application is highly recommended.
- Apply fertilizer at every irrigation to spread the overall amount across expected irrigation events throughout the relevant period.
- Start fertigation only once the system is fully pressurized.
- After fertilizer injection, irrigate with clean water for at least 30 minutes.
- If you cannot fertigate every irrigation, fertigate at least once a week.
- In case of rain, skip irrigation but do not skip fertigation. Fertigate with a high concentration of fertilizer and a small water volume.

Fertigation recommendations per growth stage

Arabica

Growth stage	Flowering	Fruit growth	Pre-harvest	Post-harvest	Sum
Graphic presentation					
N (kg/Ha)	75-100	95-125	80-100	50-75	300-400
P_2O_5 (kg/Ha)	5-10	7-15	5-15	3-10	20-60
K_2O (kg/Ha)	60-85	110-155	90-140	40-80	300-460

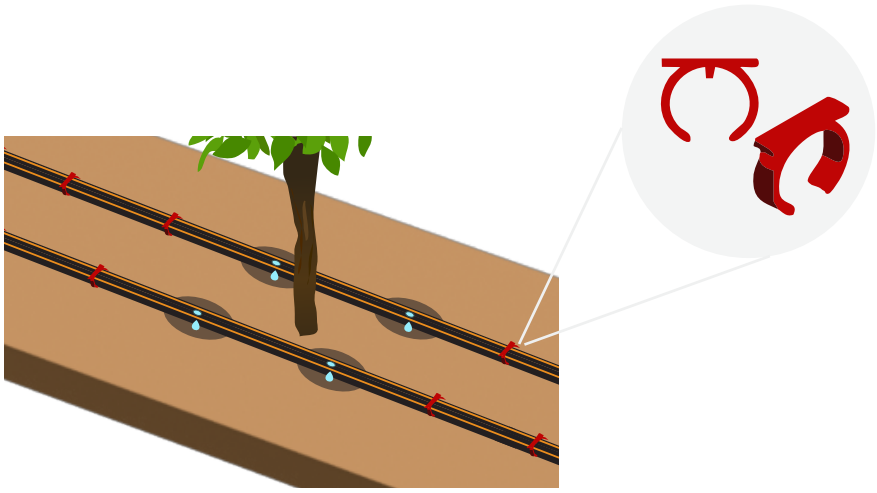
Robusta

Growth stage	Flowering	Fruit growth	Pre-harvest	Post-harvest	Sum
Graphic presentation					
N (kg/Ha)	80-110	100-135	80-115	40-80	300-440
P_2O_5 (kg/Ha)	8-12	10-16	7-15	5-12	30-55
K_2O (kg/Ha)	70-90	120-170	100-155	50-95	340-510

Fertigation of young orchards

Fertigation recommendations

- Calculate the irrigation and fertigation as liter per tree per day (l/t/d).
- Ensure that the fertigation dose is applied close to the trunk and within the reach of the young root zone.
- Place all drippers directly above the root zone and make sure that drops do not slide along the driplines and miss their target.
- The root zone diameter is roughly parallel to the canopy diameter, so drippers that are not under the canopy do not reach the root zone effectively.
- Install compatible ring plugs on the drippers between the trees to avoid water and fertilizer waste during the first few years of fertigation. Continue opening them as the tree develops.



Apple orchard fertigation recommendation doses (years 1-3)

Year 1

	Cool					Hot						Cool
	January	February	March	April	May	June	July	August	September	October	November	December	Sum
L/T/D	4	4	8	10	10	10	12	12	12	10	6	4	
N	4-6	4-6	6-8	6-8	8-10	8-10	6-8	6-8	4-6	4-6	4-6	4-6	60-80
P_2O_5	1-2	1-2	1-3	1-3	2-4	2-4	2-3	2-3	1-2	1-2	1-2	1-2	10-15
k_20	3-4	3-4	4-5	4-5	5-6	5-6	4-5	4-5	3-4	3-4	3-4	3-4	40-50

Year 2

	Cool					Hot						Cool
	January	February	March	April	May	June	July	August	September	October	November	December	Sum
L/T/D	6	6	10	12	12	12	15	15	15	12	8	6	
N	6-8	6-8	8-10	8-10	10-12	10-12	8-10	8-10	6-8	6-8	6-8	6-8	70-90
P_2O_5	2-3	2-3	2-4	2-4	3-5	3-5	3-4	3-4	2-3	2-3	2-3	2-3	15-20
k_20	4-5	4-5	5-6	5-6	6-8	6-8	5-7	5-7	4-5	4-5	4-5	4-5	50-60

Year 3

	Cool					Hot						Cool
	January	February	March	April	May	June	July	August	September	October	November	December	Sum
L/T/D	8	8	12	15	15	15	20	20	20	15	10	8	
N	8-10	8-10	10-12	10-12	12-14	12-14	10-12	10-12	8-10	8-10	8-10	8-10	70-90
P_2O_5	3-4	3-4	3-5	3-5	4-6	4-6	4-5	4-5	3-4	3-4	3-4	3-4	15-20
k_20	5-6	5-6	6-7	6-7	7-9	7-9	6-8	6-8	5-6	5-6	5-6	5-6	50-60

Example

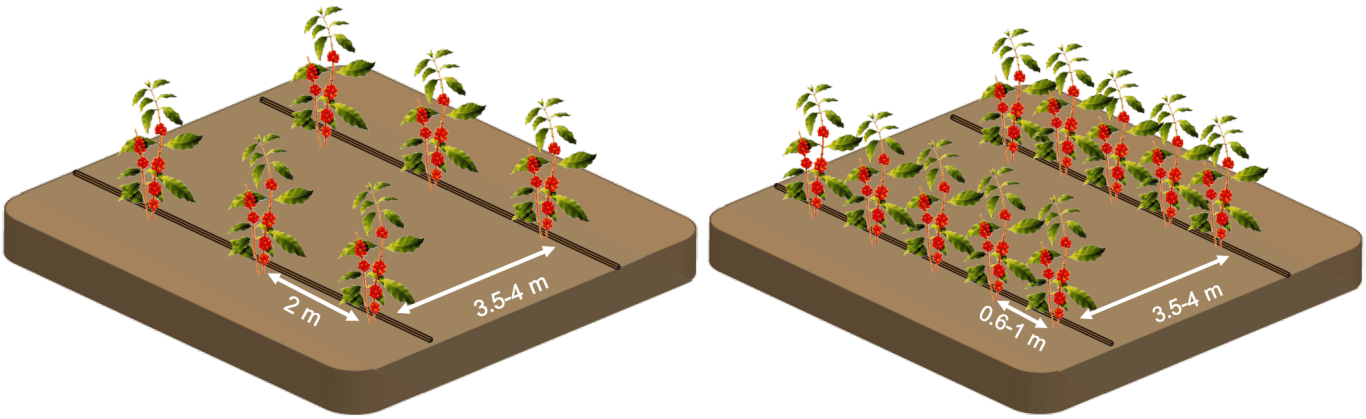
- First-year orchard has 2 effective drippers of 1.0 l/h near the root zone
- 2 drippers per tree of 1.0 l/h = 2 l/h/t
- Recommended daily irrigation level is 10 l/t/d

$$\frac{10\ \text{l/t/d}}{2\ \text{l/t/d}} = 5\ \text{hours/tree/day}$$

- Irrigate for 5 hours per shift per day

Drip Irrigation Configurations

On-surface



Traditional planting

Plant spacing: 2 m
Crop rows spacing: 3.5-4 m

Drippers: UniRam™ / DripNet™ PC
Flow rate: 1-2.3 l/h
Dripper spacing: 0.5 m
Driplines per crop row: 1

Dense planting

Plant spacing: 0.6-1 m
Crop rows spacing: 3.5-4 m

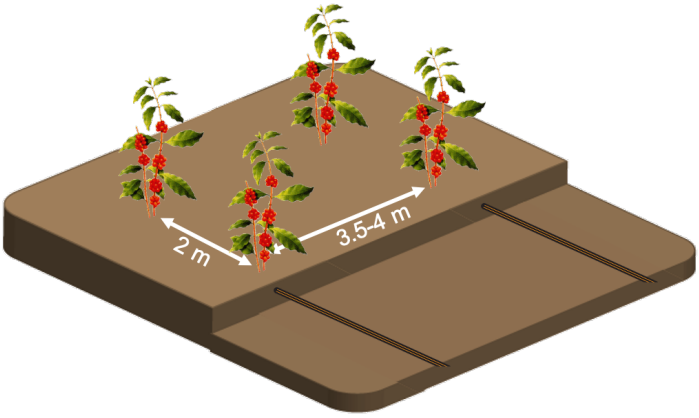
Drippers: UniRam™ / DripNet™ PC
Flow rate: 1-2.3 l/h
Dripper spacing: 0.5 m
Driplines per crop row: 1

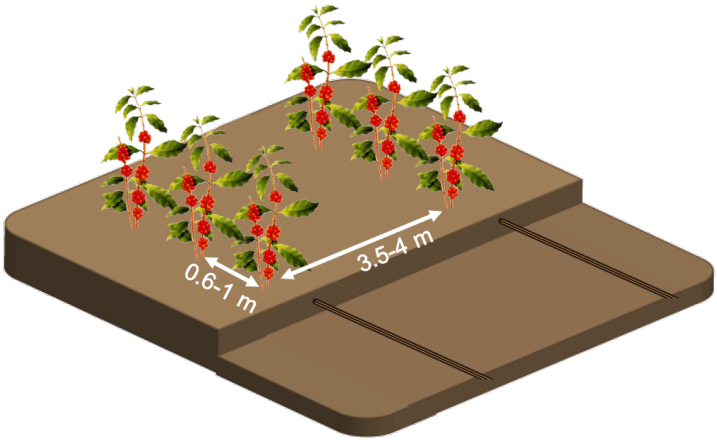
Dripper spacing and flow rate should be determined based on soil type, climate and variety.

Subsurface drip irrigation (SDI)

Subsurface is a popular drip application method for coffee, offering several advantages.

- **Easier cultivation** – SDI eliminates the need to move or adjust driplines prior to above-ground tractor operations to facilitate the cultivation process.
- **Lower physical and mechanical damage** – SDI protects driplines and cultivation equipment from physical damage and enables full harvesting operations without damaging the drip system.
- **Less disease** – SDI reduces the level of humidity near the tree trunk to lower the prevalence of disease.
- **Fewer weeds** – SDI ensures that the irrigated water remains underground in the root zone to ensure a clean, relatively weed-free orchard.





Traditional planting

Plant spacing: 2 m
Crop rows spacing: 3.5-4 m

Drippers: UniRam™ AS XR / DripNet™ AS XR
Flow rate: 1-2.3 l/h
Dripper spacing: 0.5 m
Driplines per crop row: 1

Dense planting

Plant spacing: 0.6-1 m
Crop rows spacing: 3.5-4 m

Drippers: UniRam™ AS XR / DripNet™ AS XR
Flow rate: 1-2.3 l/h
Dripper spacing: 0.5 m
Driplines per crop row: 1

Dripper spacing and flow rate should be determined based on soil type, climate and variety.

Netafim Solutions for Coffee

UniRam™

Integral pressure-compensated dripper with continuous self-flushing, featuring the largest filtration area and widest flow passages in the market, ensuring efficient, long-lasting performance over the years — ideal for multi- seasonal crop applications.

Pressure compensated

Self-flushing mechanism

Physical root barrier

DripNet™ PC

Integral, compact pressure-compensated (PC) anti-siphon mechanism dripper for semi-permanent drip applications for growers seeking a rapid ROI. Ideal for field crops in complex topographies and subsurface applications.

Pressure compensated

Self-flushing mechanism

Drainage mechanism

Got more questions? Consult our global expert. Click here

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