PROCESSED TOMATOES





Higher Brix & Higher Yields

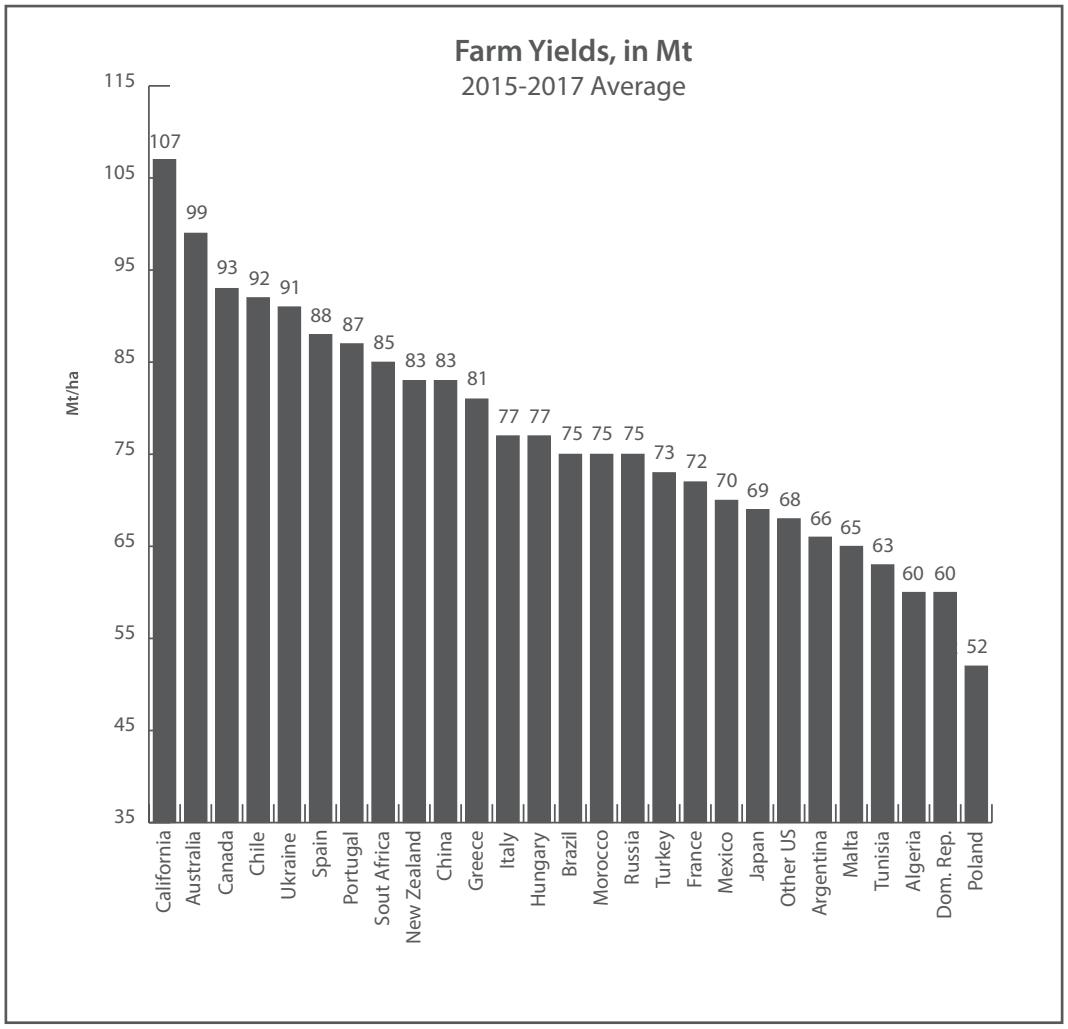
Rivulis

www.rivulis.com

Improving Production Every Year

Over the past 20 years, processed tomatoes yields have increased by 60% globally, with the average yield increasing from 52 Mt/ha in 1997 to 83 Mt/ha in 2017.

While overall yield is increasing, there is significant variance between geographies. California, the largest producer of processed tomatoes globally, yields an average of 107 Mt/ha, compared to Argentina, Mexico, France and Turkey which average between 66 – 73 Mt/ha.



1 François-Xavier Branthôme. Agricultural yields: 60% increase over 20 years (2018)

By choosing the right irrigation system, growers around the world can transform and improve their existing production yields.

Take California for example, where over the past 20 years, growers have transitioned from sprinkler and flood irrigation to advanced subsurface drip irrigation systems resulting in the significant yield increases shown above.

Rivulis offers the widest range of drip irrigation solutions, so you can accurately irrigate your tomato crops to maximize the 120 day crop cycle and achieve the best brix rating and yields.



Drip irrigation improves fruit quality

Size, firmness, color consistency, brix level, content, lycopene content, pH, shelf life, hollowness and cracking.

Why Drip Beats Overhead Sprinkler Irrigation

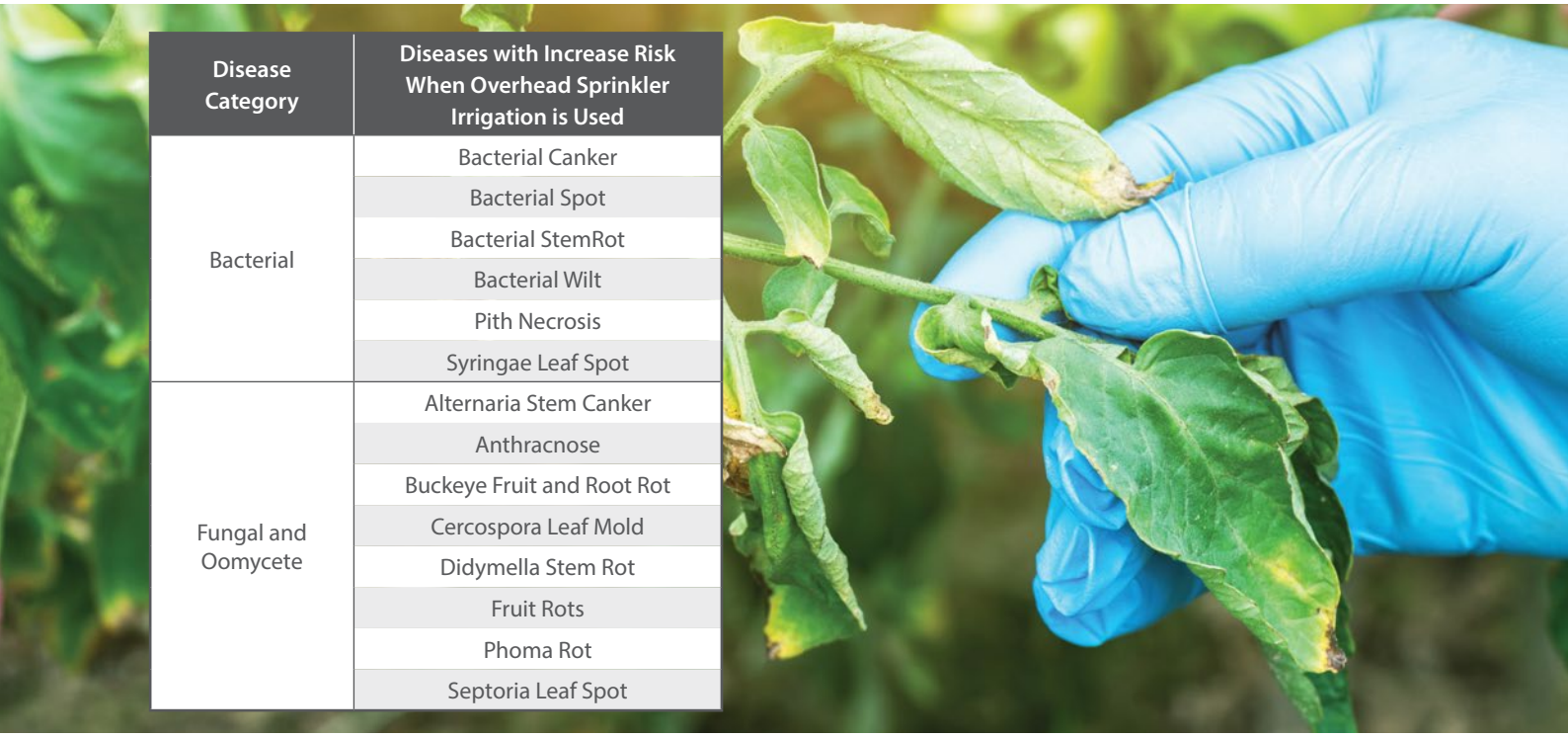
Decreased Disease Risk

Tomatoes, along with many crops in the Solanaceae family, are extremely sensitive to leaf disease.

Moisture on the canopy from overhead sprinkler irrigation can lead to disease which will cost you in yield and quality. Drip irrigation delivers the right amount of water to the root of the plant, preventing water from gathering on the leaves.

The table below features some of the diseases that more frequently occur due to overhead sprinkler irrigation.

Disease Category	Diseases with Increase Risk When Overhead Sprinkler Irrigation is Used
Bacterial	Bacterial Canker
	Bacterial Spot
	Bacterial StemRot
	Bacterial Wilt
	Pith Necrosis
	Syringae Leaf Spot
Fungal and Oomycete	Alternaria Stem Canker
	Anthracnose
	Buckeye Fruit and Root Rot
	Cercospora Leaf Mold
	Didymella Stem Rot
	Fruit Rots
	Phoma Rot
	Septoria Leaf Spot

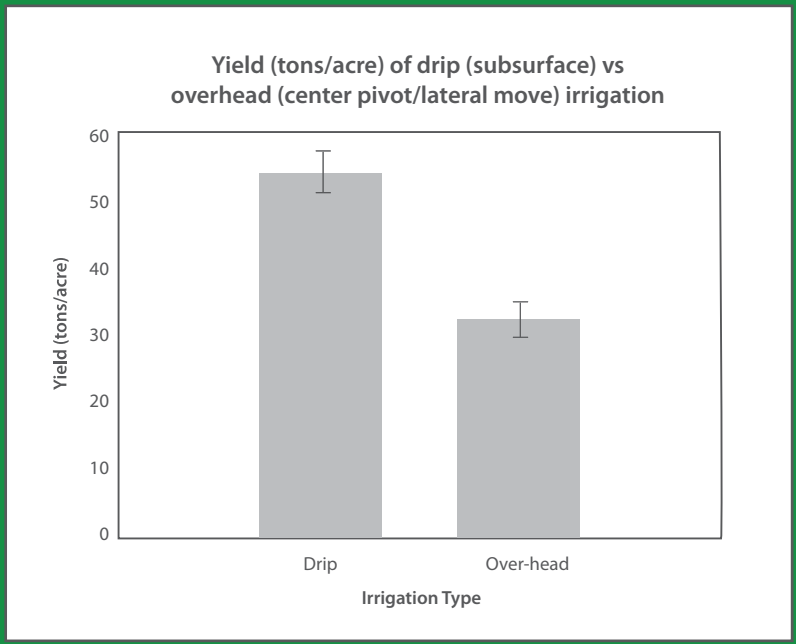


Increased Yield

There are many studies proving that drip irrigation leads to significant yield increases compared to overhead sprinkler irrigation.

The study below shows that with drip irrigation, tomato yield was 48% higher with drip irrigation

2-year Comparative Study:
University of California's West Side Research & Extension Center



Direct from the research...

"Tomato yield was 38% greater in 2012 than in 2010 and averaged over the 2 years, 48% higher yield using drip than in the overhead systems, respectively, due presumably to the higher soil water evaporation losses of the overhead system relative to the drip system and also, we propose, to the ability of the drip system to very precisely apply in-season fertigations directly to the crop root zone while overhead fertigations were applied at the soil surface and over a greater area...

A final contributing factor to the lower yields of the overhead system centers on how in-season liquid fertilizer was applied via the two irrigation systems. With the drip system, fertilizer applications were made directly to the root zone of the tomato plants where acquisition and uptake occur. However, in the OH system, fertilizers were applied throughout the entire planting bed area including the furrow and we postulate that this more diffuse application method may have been a major contributing factor to both the restricted growth."

Mitchell, Shrestha, Klonsky, Turini, Hembree. Overhead and Drip Irrigation System Effects on Tomato Growth and Yield in California's Central Valley. American Society for Horticultural Science. (2014).

Precision Production Calls for a Precision Irrigation System

Maximizing brix and yield required precision production practices. This balance is only possible when precision irrigation is used – an irrigation system that optimizes flow-rates, dripper spacing and the best system for the application.

Optimizing flow rates and dripper spacing

Knowing your soils enables you to choose the right dripper flow rate (flow per dripper) and spacing (distance between drippers) for your crop.

Getting this combination right is important to:

- Ensure all tomato plants receive water and nutrients at their root zone
- Minimize leaching of water and nutrients through the soil profile
- Avoiding overwatering or under watering which leads to poor uniformity

It is a common belief that applying more water will cause it to spread further laterally. However generally this is not the case, especially in sandy soils.

By applying dye through a drip irrigation system and then cutting away the soil, we can see how water moves.

Application 1 Low flow rate, close spacing, low water application		■ **Drip line:** 1 lph drippers at 20 cm spacing ■ **Water applied:** 0.5 l ■ **Water movement:** ▪ *Spread:* 18 cm ▪ *Depth:* 29 cm
Application 2 High flow rate, wide spacing, high water application		■ **Drip line:** 8 lph drippers at 50 cm spacing ■ **Water applied:** 2.0 l ■ **Water movement:** ▪ *Spread:* 23 cm (+5 cm from Application 1) ▪ *Depth:* 60 cm (+31 cm from Application 1)

Rohan Prince. Using dye to show water movement below drip irrigation. Department of Primary Industries and Regional Development. Government of Western Australia. (2016)

In the above test, you can see in Application 2 that using higher flow drippers and wider spacing between drippers only results is in a 5 cm wider spread of water, despite applying four times the volume of water. Additionally, there was significant water loss through the soil profile. The root zone of a tomato plant is only 250 mm deep, meaning that all water movement below this point is lost water and nutrients. In other words, most of the water in Application 2 using the high flow, wide distance system was lost and never reached the root zone.

For a precision drip irrigation system, it is recommended to have close dripper spacings and lower flow drippers. Generally a 0.75 – 1.0 lph flow-rate is sufficient with dripper spacing of 20 cm for sandy soils and 30 cm for heavier soils.

Drip Irrigation Systems

There are three commonly recommended drip irrigation systems for processed tomatoes; single season on surface, retrievable multi-season on-surface, and multi-season sub-surface.

Single Season on Surface

In this application, drip line/tape is used for only one season. At the conclusion of the season it is retrieved for recycling. Benefits include easy installation, less maintenance and more economical.

Recommended drip lines:

- 6 mil wall thickness in light soils and 8 mil wall thickness in heavier soils
- 20 – 30 cm dripper spacing
- 0.75 – 1.0 lph drippers
- Rivulis T-Tape & Ro-Drip: Longer roll lengths to minimize change-overs during installation
- Rivulis D900, D1000 and Eurodrip Compact: High performance thin wall drip lines with an inserted emitter for single season applications

Installation:

- Install during planting
- Can be installed on surface or shallow burial of a few centimeters to prevent movement by wind
- One drip line lateral per plant row



The perfect match: Rivulis H6000 PE Layflat

Standard layflat is plagued with problems of leakage. Excessive surface water is detrimental to tomato crops. Additionally, it creates a mess with machinery and bogging.

Rivulis H6000 PE Layflat addresses this problem with outlets molded directly into the layflat. The result, years of leak-free irrigation. Additionally, as the outlets are pre-installed, setup each season of your irrigation system is faster and simpler.

Retrievable Multi-Season on Surface

The drip line is retrieved and stored at the end of each season for re-use.

This system provides you with maximum flexibility to use the system in different applications and locations each season. As tomatoes are a very sensitive crop, a system designed for tomatoes will be suitable to grow numerous other crops.

The heavy wall tube will provide many years of use. In addition, you can select a Pressure Compensated (PC) drip line for longer run lengths and the ability to install in more sloping terrain compared to standard drip line

Recommended drip lines:

- Minimum 30 mil wall thickness drip line to ensure strength for multiple installations and retrievals
- 20 – 30 cm dripper spacing
- Generally use 1.0 lph flow-rate
- Rivulis D5000 PC, Hydro PC and Eurodrip Olympos PC: Provide pressure compensating for longer run lengths
- Rivulis Hydrogol, D2000 and Eurodrip NGR: For non-PC applications with shorter run lengths and on flat ground

Installation:

- Install on surface prior or while planting
- One drip line per row
- Does not need to be buried due to extra weight of the drip line





Subsurface Drip Irrigation

- Drip line/tape is installed 20 – 30 cm below the ground for multi-season use
- The most efficient application of water and nutrients
- Keeps the surface dry to help reduce humidity and disease
- Can be rotated with alternate crops such as cotton
- Average life-span of 5 – 7 years. Install once for multiple seasons

Recommended drip lines:

- Subsurface applications require 12 – 15 mil wall thickness drip line / tape. Heavier wall thicknesses can be used for harsher soil environments
- 20 – 30 cm dripper spacing
- Flow rate of 0.6 – 1.0 lph
- Rivulis T-Tape features a slit to help prevent soil ingestion at shut off
- Rivulis Hydrodrip and Eurodrip Eolos are available up to 25 mil wall thickness for extra strength

Installation:

- 30 cm depth for heavier soils. Reduce to 20 cm depth for sandy soils
- Install directly under row of tomatoes prior to planting



The perfect match: F2000/F2400 Media Filters & F7250 Automatic Disc Filters

A subsurface irrigation system requires the best protection to ensure numerous years of use.

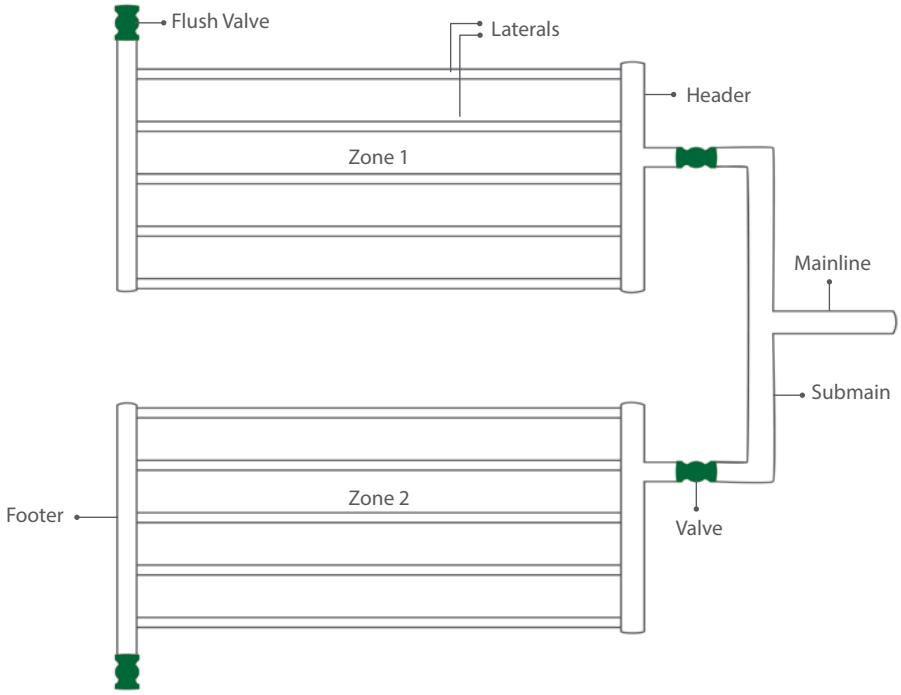
Both the Rivulis F2000/F2400 Media Filter and the F7250 Automatic Disc Filter are excellent for subsurface irrigation as they provide '3 dimensional' filtration, making them highly effective in removing both organic and inorganic matter.

Flushing Laterals

Processed tomato production is highly mechanized with an emphasis on efficiency. It therefore makes sense to also automate the maintenance of drip line cleaning as much as possible. This can be achieved by using flushing laterals.

Flushing of drip line laterals is an important aspect of drip line maintenance. This can be done manually through opening each drip lateral manually, or save labor by installing a flushing lateral. All drip lines are connected to this lateral which has a valve that vents to atmosphere.

Flushing is as simple as opening the valve to expel debris from the drip system.



Flushing should occur every 10 – 15 days according to water quality.

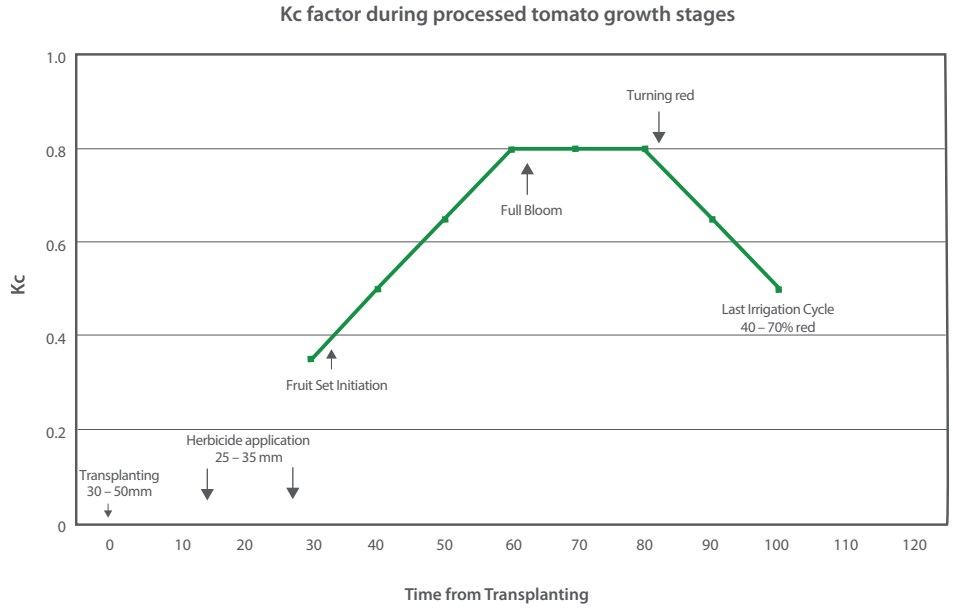
- Acid treatment: (0.1 – 0.5%)
  - Reduce pH and avoid carbonate precipitates clogging
- Chlorination: (25 – 50 ppm)
  - Use when there is surface water supply to prevent algae clogging

The above treatment is a general guide only. Your Rivulis representative can assist you in developing a maintenance plan for your irrigation system.

Irrigation Scheduling

Processed tomatoes are a crop that requires a deficit irrigation schedule in order to maximize brix and yield. Generally, a reduction of 50% of water should be implemented as the tomatoes begin turning red to increase fruit growth and brix content.

Remember to not over irrigate and that using subsurface irrigation will require less water than surface irrigation.



The last irrigation cycle usually takes place when 40 – 60% of the fruit is red unless:

- Growing on light soil and the water content is very low
- High evapotranspiration climates
- Soil or water salinity of EC>2.5 dS/m



General Recommendations

The following are our recommendations for using a drip irrigation system for your processed tomato crops.

Irrigate immediately upon planting

Tomatoes need immediate water availability. Test your system before planting to ensure that the system is functioning correctly with water at the end of every drip lateral.

Measure flow and pressure

As your crop grows, the plants will cover your drip lines. Track your flow and pressure readings for each block so that you can detect and treat problems. Increased flow indicates leakage, whereas increased pressure indicates blocking.

Prevent root intrusion

In subsurface applications, do not stress your plants so much that the roots seek out your drippers. Root intrusion can be prevented by managing crop stress and providing the area around the drippers with sufficient moisture content.

Small frequent doses of fertilizer is better than occasional large applications

High fertilizer applications will create large leaves and vines that can lead to fungal and bacterial problems. Apply fertilizer before the plant needs it as catching up on the fertilizer requirements once in deficit is difficult. Fertigation is ideal for small frequent applications of fertilizer.

Time your water stress

It is better to stress your crop in the earlier stages of growth so that the crop develops a bigger and stronger root system. This will help your crop yield better when it is setting its fruit. If you stress your crop during fruit fill, it can be very detrimental.



" When working with suppliers, I choose to work with a few trusted partners who can provide the support I require. I chose Rivulis as they have the widest range of drip lines, and I find T-Tape is perfect for my tomato crop. Additionally, their H6000 layflat makes installation easier, and they also supply F2400 media filters – providing me with a full drip irrigation solution. Together with the service that Rivulis provides before and after installation, Rivulis is a trusted partner in my tomato production."

Francisco Javier,
Polo Farm,
Spain



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