

Maximize Your Production Potential with Drip Irrigation

Rivulis

www.rivulis.com

A World of Potential

With tens of millions of hectares under cultivation around the globe, the potato is one of the world's largest and most important crops.

But not all production is equal nor effective. *Drip irrigation is a key lever to improving yield.*

10 -15 t/ha
(Basic Production)

20 t/ha
(World Average)

40+ t/ha
(Advanced Production)



The world average is 20 t/ha[1], the average production in Germany is 42.7 t/ha[2] , and in New Zealand the average yield is 50 t/ha[3]. As such, for much of the world, there is opportunity for significant yield improvement that is easy to achieve. **Drip irrigation can help achieve these yields.**

1. ADAMA Agricultural Solutions (2017)
2. Eurostat. The EU potato sector – statistics on production, prices and trade (2017)
3. Potatoes New Zealand (2015)



Growing Potatoes to Meet Market Requirements

For most regions, there is no such thing as just growing 'general potatoes'. From the onset, a growing program needs to be developed in order for the potatoes to meet the strict market requirements for their final use.

Market guidelines for potato quality are becoming stricter, resulting in reduced profit and sometimes complete rejection of crops that do not meet the market specifications.

In this brochure, we share how drip irrigation can help you grow the right potatoes for each market need.

Guidelines for Potatoes By Market

Potato Crop



Fresh Market

- Large size
- Consistent shape
- Good skin
- Lower dry matter to help prevent bruising and for better cooking



Processed Market

French Fries

- Large size
- Increased dry matter
- Color grading very important



Crisping

- Medium-large tubers
- High dry matter
- Very low sugars to prevent browning when cooked



Canning

- Small size
- Low dry matter



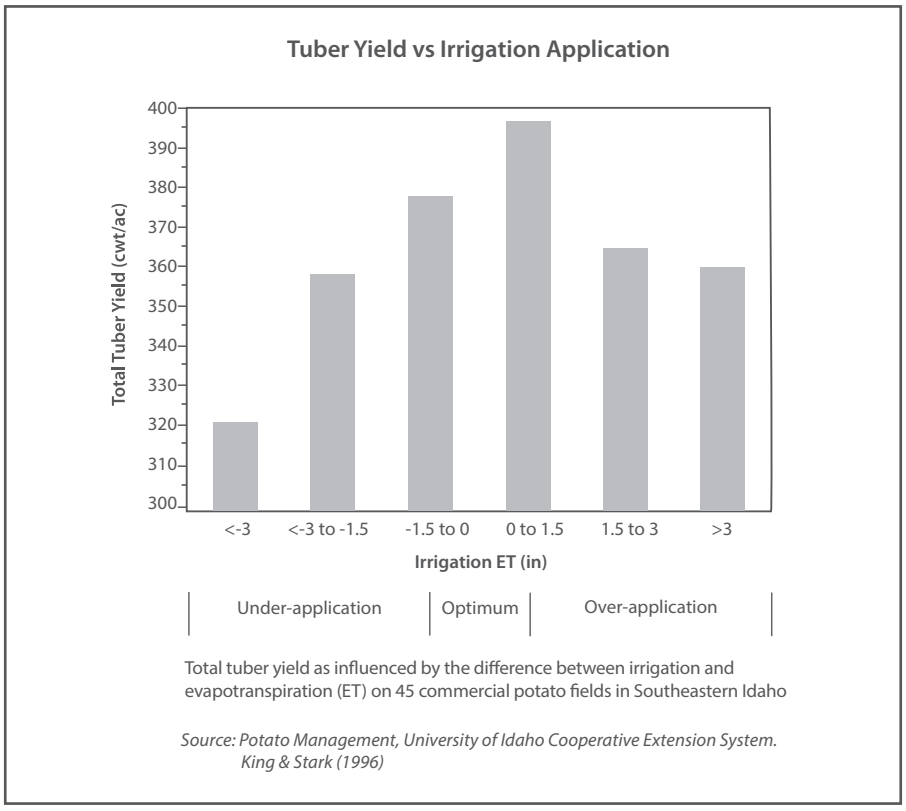
Applying Just the Right Amount of Water

Potatoes have a water requirement that can reach up to 25 mm/week during bulking. At the same time, they are very sensitive to both under and over irrigation that can damage the plants and in turn, the tubers.

There are two reasons for this sensitivity:

1. Potatoes have a very shallow root system that prevents them from reaching deeper nutrients and water

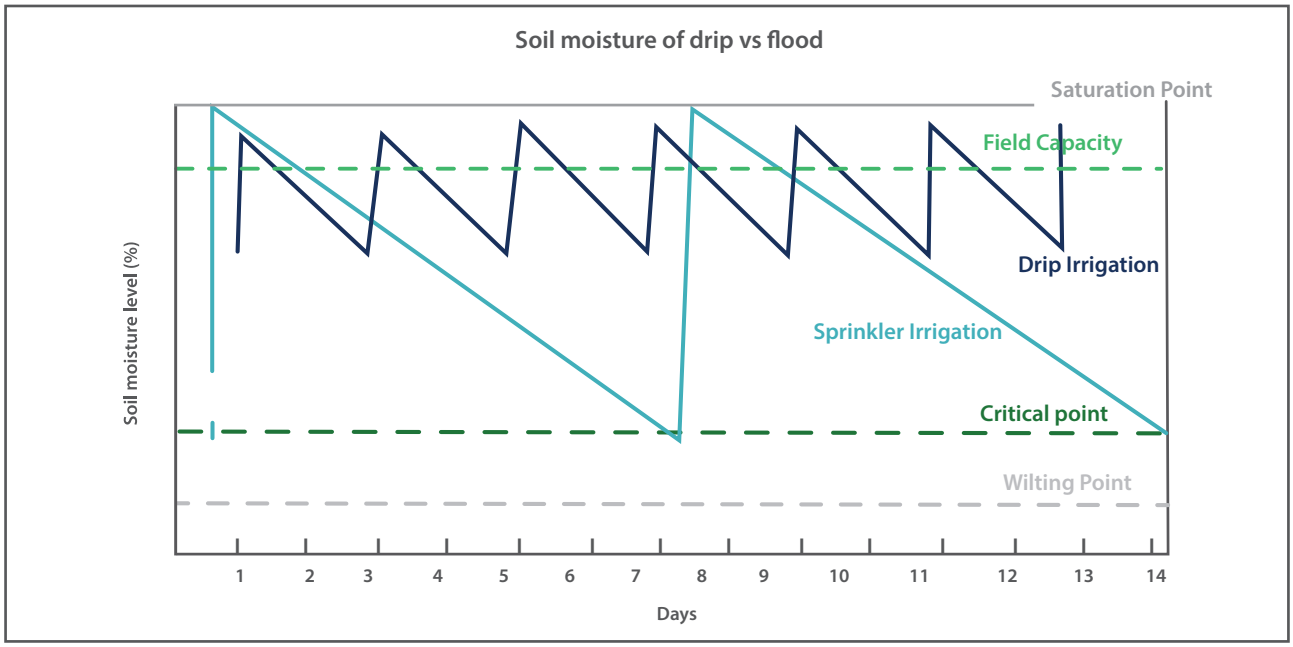
2. The tubers are very susceptible to damage during the growth stage and from disease.



Total tuber yield as influenced by the difference between irrigation and evapotranspiration (ET) on 45 commercial potato fields in Southeastern Idaho

Source: Potato Management, University of Idaho Cooperative Extension System. King & Stark (1996)

Accurate water management is critical to achieve the best yields and drip irrigation makes it possible to keep the soil moisture level close to Field Capacity through frequent but small irrigation applications.



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Inaccurate water application can damage your crops:

Too Much Water Leading to Saturation Periods 	■ Saturation of the soil profile for more than 8 –12 hours can cause root damage. ■ Over watering causes a higher rate of brown blight, hollow heart, tuber splitting, and general reduction of tuber quality. ■ Nitrogen can leach below the plant's shallow root zone.
Too Little Water Leading to Water Stress 	■ Water deficits reduce the plant's growth by reducing the water pressure in the plant's cells that are necessary for expansion which then correlates directly to reduced / stunted tuber expansion.
Too Much Variation 	■ During water deficit, tuber expansion reduces or even stops. Once water is returned and the plant is not in stress, tuber expansion will resume; however tuber malformation likelihood increases. The wider the variation, the greater the problems of malformation.



Not All Irrigation is Created Equal

It is well established that potatoes have a very high sensitivity to water.

However, just using any type of irrigation throughout the field will not solve the problem, even if on paper, it meets the crop water needs.

If the irrigation itself is not uniform, you can create variability across the field which causes the crop damage.



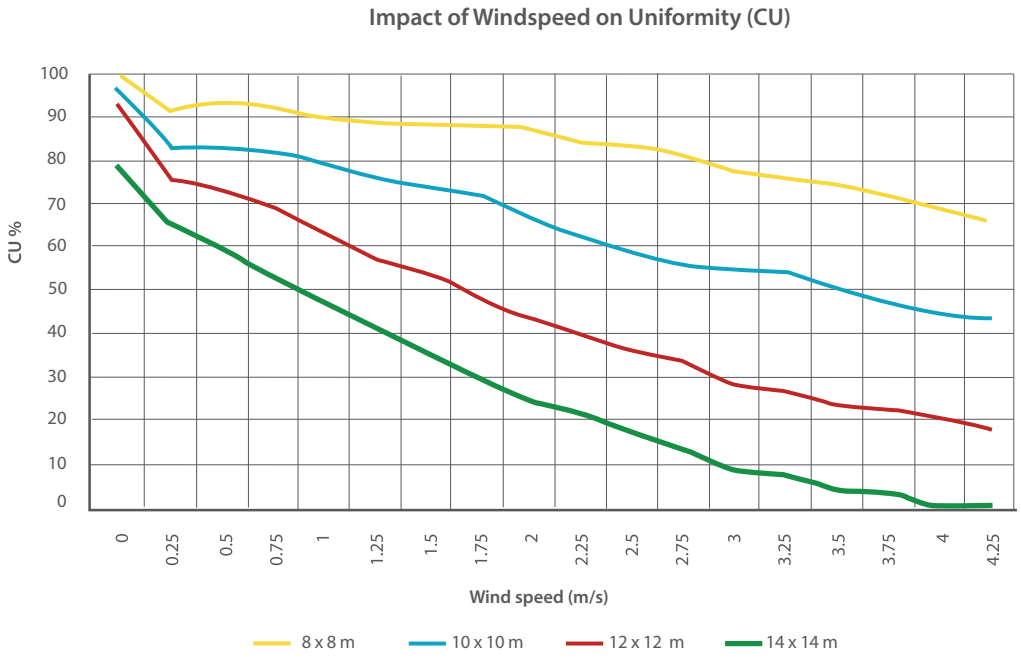
Russia Field Study

Average 25% increase in potato yields was experienced by growers using drip irrigation compared to those who irrigated with pivots. **Fields in Astrakhan region with drip irrigation achieved yields of 60 t/ha!**

The Wind Factor

Potatoes are often grown in windy conditions and a major downfall of using sprinklers for irrigation is that they do not perform well in wind.

Some sprinklers can deliver high 'published' uniformity; however, these tests are performed in labs, not in the field. As the graph on the next page demonstrates, sprinkler uniformity drops quickly as wind speed increases. This reduced uniformity leads to some plants receiving too much water, and others receiving too little.

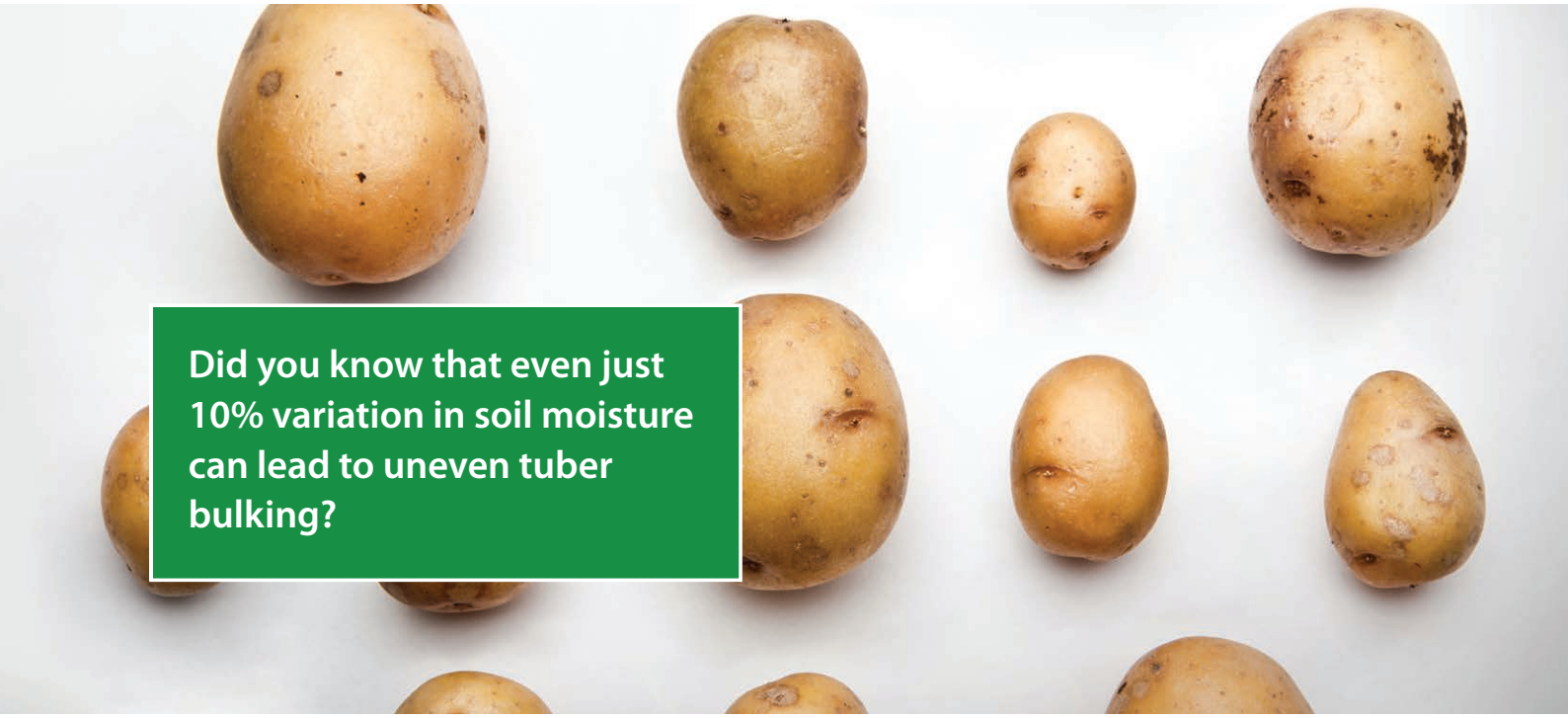


Evaluating your irrigation system: measuring uniformity and adequacy. Knox. (2018)

Christiansen's Uniformity Coefficient (CU)

Used to calculate the uniformity of sprinkler systems. The chart above shows CU reduction as wind speed increases. The lower the CU, the greater variation of water applied across the field.

$$CU = 100^{*}\left[1.0 - \frac{\Sigma|z - m|}{\Sigma z}\right]$$



Did you know that even just 10% variation in soil moisture can lead to uneven tuber bulking?

Accurately Apply Chemigation with Drip

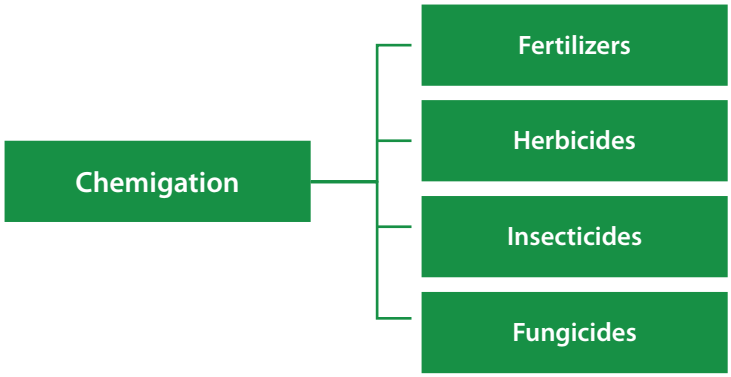
Application of N, P, K, Ca, Mg, S, B, Mn and Zn have a direct impact on yield, tuber size, tuber number, dry matter, internal structure, skin, storage potential, cooking potential, and tuber strength.

To produce a crop that is 'in-spec' for its final market, you need to get all these nutrients right using the right amount at the right time and at the right location. Too much nitrogen for example, and you increase your foliage while decreasing dry matter and starch.

One of the major benefits of drip irrigation is the ability to apply chemigation (fertilizer, herbicides, insecticides and fungicides) accurately and effectively by injecting it into the irrigation system itself. Fertilizer, insecticides and fungicides are easily applied directly to the root zone with over 90% uniformity, without manual labor or tractor use.

Sprinklers do not provide this flexibility or accuracy and you need a tractor to apply the nutrients, which requires more resources (fuel, equipment and labor) and is less efficient as nutrients are lost.

Additionally, sprinklers increase humidity and increase the risk of black leg disease. Sprinklers also irrigate the interrows so that additional weed control is required, and foliage is wet increasing the risk of late blight and target spot. Worse yet, sprinklers wash off the fungicide that has been applied so you are not protecting your plants completely, while wasting valuable fungicide that runs off into the soil.





Field Study:
Sprinkler vs Drip in Australia



- **Name:** Peter Grayson
- **Location:** Queensland, Australia
- **Drip Irrigation Solution:**
  - Rivulis T-Tape 510-30-340
  - 180 m row lengths
  - 1% downhill slope
  - Row spacing 0.8m
  - 1 drip lateral per row
  - Application: 4.5 mm of water per hour at 1.0 bar

Irrigating with Rivulis T-Tape, Peter Grayson achieved 50% water savings and 25% yield increase compared to blocks irrigated with sprinklers.

English Potatoes Rivulis T-Tape vs Sprinkler Comparison Summary

Irrigation Method	Tonnage Yield (less waste and under size)	Water Use
Overhead sprinkler	37.2 t/ha	5.0 (Ml/ha)
Rivulis T-Tape	50.8 t/ha	3.0 (Ml/ha)

More money in your pocket…

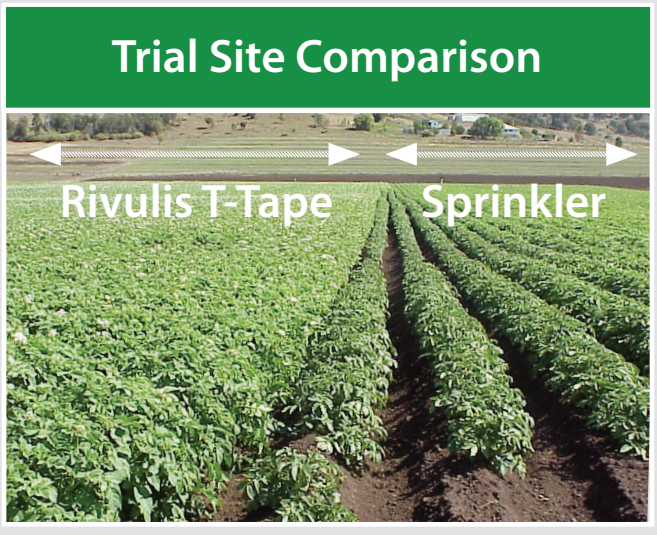
As the table on the following page shows, the Rivulis T-Tape block produced 36% more revenue per hectare compared to sprinkler irrigation. Additionally, using drip irrigation, Peter harvested a higher percent of larger and more uniform potatoes (compared to using sprinklers).

Financial Analysis of Drip vs Sprinkler Comparison *(Peter Grayson - Continued)*

Sprinkler Irrigation			
Size Range (mm)	**Percent of Total**	**Yield x Size (t/ha)***	**Income (AU$/ha)***
<50	12.0%	5.4 t/ha	$1625.00
50-70	50.2%	22.7 t/ha	$6795.00
>70	37.8%	17.1 t/ha	$5124.00
Actual Total		40 t/ha	$12000.00
Actual Total less waste & undersize		**37.2 t/ha**	**$11180.00**

Rivulis T-Tape Drip Irrigation			
Size Range (mm)	**Percent of Total**	**Yield x Size (t/ha)***	**Income (AU$/ha)**
<50	4.0%	1.9 t/ha	$577.03
50-70	41.5%	19.8 t/ha	$5949.84
>70	54.4%	26.0 t/ha	$7799.06
Actual Total		54.1 t/ha	$16230.00
Actual Total less waste & undersize		**50.8 t/ha**	**$15240.00**

** Size sampling was determined from random selection and measurement of crop from 5 rows x 2 m of each trial. "Actual Total" is the results of the entire trial site.*



Choosing the Right Drip System

Processed (crisping, french fries and canning) have different needs, and therefore different irrigation recommendations compared to potatoes grown for the fresh market.

Single Row Drip System

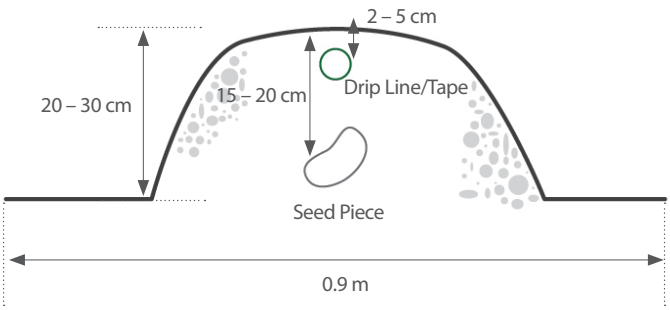
When growing for the fresh produce market, quality and consistency is key.
For this reason, it is recommended to have one drip line/tape per row of potatoes for all fresh market crops.
A single row drip system is also recommended for processed market potatoes in many applications.

Typical Installation:

- 90 cm centers
- 1 drip line/tape line per row
- Thin wall drip line/tape (4 – 8 mil depending on environmental conditions)
- 15 – 30 cm dripper spacing with 1 lph flow per dripper depending on spacing. Goal is approximately 3 lph per meter. Slow application of water is beneficial as it helps keep the soil soft, especially on clay where skin damage during harvest is a risk.
- Install drip lateral above the seed and bury with 2 – 5 cm of soil
- It is best to install at the same time as planting to avoid damaging the new shootings from the seed.

Tips:

- Common scab is a major challenge with fresh market potatoes. To minimize this, you need to keep the moisture level sufficient through tuber initiation and just after "hook" stage. After this stage, you can revert to more supplementary irrigation scheduling.
- As the season progresses and more ridging is made, the depth of your drip line/tape can be up to 20 cm by the end of the season. When the drip line/tape is this deep, there is much greater distance for the water to reach the surface. Therefore, do not rely on seeing a wetting pattern. If you rely on seeing it, you run the risk of over irrigating. Instead, moisture can be measured quickly and economically with a basic tensiometer.





Interrow Drip System

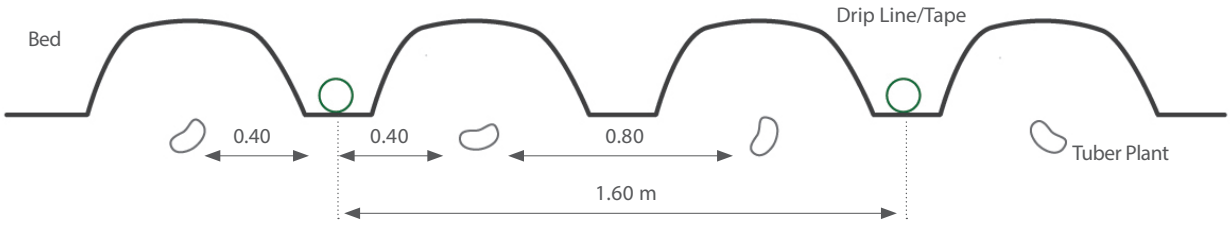
For processed markets, there is more flexibility in systems to choose from. It is possible to use one drip line/tape per row of potatoes, or you can also use a re-usable pressure compensated system with a drip line installed every two rows.

Typical Installation:

- 160 cm centers
- 1 drip line per 2 rows of potatoes distanced 80 cm apart
- Drip line is placed in the shallows of the ridges
- Heavy wall (above 30 mil wall thickness) PC drip line is used
  - Heavy wall allows for multi-season reuse
  - PC drip line provides accurate flow over wide pressure ranges (sloping round and long-run lengths)
- 30 cm dripper spacing with 1 lph dripper
- Shallow burial of the drip line is recommended

Tips:

- This system is excellent for leased land as it is portable and flexible for a wide range of other configurations.
- It is not recommended for saline water. As potatoes are sensitive to salinity, it is better to use a 1 drip line/tape per row system as this will 'push' the salt residue away from the roots and leach into the soil.
- Avoid having dripper spacing of more than 30 cm as this can result in tuber bunching around the outlets of the drippers, resulting in inconsistent tube size.





Find the Right Rivulis Drip Line or Tape

There are three common drip irrigation systems that you can install based upon your needs.

Drip Solutions for the Fresh Market

Thin Wall Drip Lines and Drip Tapes

Reserve



T-Tape



T-Tape^{S}



D900



D1000



D1500



Ro-Drip



Hydrodrip



Eolos



Eolos Compact



Drip Solutions for the Processed Market

Medium-Heavy Wall Drip Lines

D2000



NGR



Hydrogol



GR



Pressure Compensating Drip Lines (PC)

D5000 PC/AS



Hydro PC/PCND



Olympos PC/AS



PC2



D4500 PC/AS



R5000 PC





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