TORO®

Drip irrigation in Citrus groves

Improve quality and simplify your work.

citrus fruits

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The demand for citrus fruits, with lemons in the lead, continues to increase. The production of some types of citrus fruit, including in the main producer countries, is unable to satisfy even internal demand. The use of citrus fruits continues to grow steadily in the processing industry too. These factors combined require an increase in production.
This increase in production is achieved through a modernisation of the cultivation methods, the mechanisation of activities, the increase of plants per hectare, but mainly through an increase in the quantity and quality of the plant yield.
To increase production and at the same time to improve the quality of the crop. This is the main challenge that all citrus growers must accept: the ease of sale and the profitability of the plants depend on this.
Tangerines, clementines, oranges, lemons and more: the whole citrus fruit segment today is driven by the demand of the final consumer and by the needs of both the large-scale retail trade and the processing industry.
The former demand products of high calibre, good-looking and good tasting. The latter require uniformity of size and a long shelf-life. Farmers must find answers to these demands.

IRRIGATION: THE RIGHT ANSWER

In order to increase the size of citrus fruits without altering their qualitative characteristics, it is necessary to intervene with the right amount of water.
Citrus fruits require adequate water availability throughout the year.
In the autumn-winter periods this requirement is ensured by rain; during the other seasons, irrigation must be provided for. The amount of water to be supplied depends on the leaf surface, the age of the plant, evaporation and the weather.
The stages requiring particular attention are those immediately following the fruit setting stage. At this stage, cells need large amounts of energy. If you feed the plant effectively, you can promote its metabolism and minimise the stress which characterises this stage. The plant will thus be able to work at its best and produce larger-sized fruits, without compromising their quality.
In general, annual water consumption for citrus fruit varies between 750 mm in temperate zones to about 1200 mm in arid zones.
The rational management of water is essential to achieve adequate quantity-quality production. Citrus fruits are able to save water, overcoming even prolonged periods of drought; however, in order to achieve an abundant, high-quality production, with a reduced physiological fruit drop, the plants must not suffer periods of water stress.
Various experiments have shown how constant irrigation during the summer results in larger fruit sizes. Several studies have shown that the shorter the irrigation cycle, with an obvious increase in frequency, the larger the size of the fruit; on the contrary, as the irrigation cycle lengthens, the size decreases.

THE IRRIGATION SYSTEM: THE ADVANTAGES OF DRIP IRRIGATION

The choice of irrigation system depends on several factors, such as the characteristics of the land, its orography, the field surface, the water availability, the water cost and quality. When the availability of water resources is limited, preference must be given to systems that favour optimal management, both to

save water and to limit operating costs (energy). In recent decades, gravity and sprinkler systems have given way to localised systems, particularly drip irrigation systems.

The advantages of this system over others are:

- better use of the water supply;
- no ground levelling is necessary;
- it allows work mechanisation;
- it allows you to properly manage the frequency and intensity of irrigation;
- it allows fertigation.

A year-long study[1] was carried out on three citrus groves: the first one not irrigated, the second irrigated by sprinklers and the third one by drip irrigation. With fairly normal rainfall, it was observed that without irrigation there was a lack of moisture in the soil under the citrus fruit canopy, at a depth of about 40 cm, for about half of the observation time (1 year).
With the sprinkler irrigation, the situation obviously improved and the moisture in the soil under the trees increased, reducing the period of shortage. However, a lack of soil moisture was observed in about one third of the days covered by the study year even in the case of sprinkler irrigation.
The soil with drip irrigation, on-line drippers or dripline, remained moist for the entire year, without showing any lack of humidity or water stress.

POSSIBLE CONFIGURATIONS FOR YOUR CITRUS FRUIT GROVES

PRODUCTION PERIOD

- OPTION 1 (SDI Irrigation)
  (AQUA-TRAXX® PBX OR FLOWCONTROL™)

  During the breeding period, use Aqua-Traxx® with a 20-30 cm spacing and a 0.87-1.14 l/h flow rate, at a depth in the terrain of 20-30 cm and positioned at 30-50 cm from the plant.
  Buried Aqua-Traxx® will ensure that the hydric and nutritional demands of the growing plant are met.

- OPTION 2 (SURFACE IRRIGATION)
  (NEPTUNE PC AS)

  In the case of surface irrigation use a Neptune PC AS (Pressure Compensating and Anti-Siphon) drip line: with a dripper spacing of 20-30 cm, a flow rate of 1.2 or 1.6 l/h, positioning it at a distance of 25 cm in the first phase and moving it away to 75 cm in the first year up to 90 cm in the second year.

PRODUCTION PERIOD
(NEPTUNE PC IN SUB-IRRIGATION AND ON THE SURFACE)

Unless you use grouped spacing, the more you reduce the spacing the more you will have a continuous and even wet strip.

1 Study conducted by J. Mostella Myers, D. S. Harrison and W. J. Phillips, Jr. at IFAS | University of Florida.

SDI

Adopting a sub-surface drip irrigation system (SDI) has further advantages:

- A further increase in irrigation efficiency thanks to the reduced loss by evaporation.
- Greater fertigation efficiency with a consequent further saving in terms of fertilizers;
- A high absorption of "low-mobility" substances such as phosphorus and potassium as they are distributed close to the root system;
- No above ground tubing in the grove and consequently easier cultivation and less visual and environmental impact.

For good results, the wet surface, at a depth of 30 cm, must be at least 40% of the crown projection. During the production period, in order to obtain the right wet surface, use TWO LINES (in SDI or SURFACE) of Neptune PC AS (Pressure Compensating and Anti-Siphon) dripline, with 30-40 cm dripper spacing, 1.2 or 1.6 l/h flow rate (for one of the two lines we could use the line used during the production phase). If the planting layout is very wide, dripper spacings of 60-70 cm can also be used, with a flow rate of 2.4 l/h.
Place the driplines at a distance ranging from 60/90 cm to 120/130 cm from the plant. The choice depends on the quality of the plants and on their particular size during the production phase.
In the case of sub-irrigation, bury the lines at a depth of 30-45 cm. The advantages in the case of SDI will be: using less water and fertilizers, reducing irrigation times, cleaning the soil thus facilitating the main cultivation operations.
Should you have a planting layout with rows at 3 metres, you can opt for a solution with a SINGLE central line, in SDI, of Neptune PC AS, with dripper spacing at 30-40 cm, flow rate of 1.6 or 2.4 or 3.8 l/h. Bury the dripline at a depth of 40-50 cm. Although this solution does not have the effectiveness of the double line, it still ensures a good result and allows containing some installation costs.

CONVERSION OF MATURE CITRUS GROVES FROM SPRINKLER TO DRIP IRRIGATION

Drip irrigation is the most efficient method for citrus cultivation. This is why many growers are considering converting the irrigation system in their established plantations. The conversion of a mature citrus orchard into a drip irrigation system requires the adoption of appropriate change management procedures. When converting existing trees, farmers must follow a few simple guidelines. Often, farmers who are unfamiliar with drip systems do not realise that more frequent watering is necessary.
Full-coverage irrigation systems require root development even away from the plant, to reach the entire wet area.
Drip irrigation systems, on the other hand, do not require root length development. These more efficient systems concentrate the water supply in a smaller volume of soil. Therefore, the first drip irrigations should rationally be more abundant, in order to quickly favour the roots adapting to the new system.

IRRIGATION MANAGEMENT IN THE FIRST CONVERSION SEASON

Drip irrigation is often adopted by farmers due to a sudden water shortage, in order to reduce water consumption. In doing so, there is a risk that trees will be stressed by a water deficit and reduce their production.
On the contrary, a large water supply is recommended during the first year after conversion. After conversion to drip irrigation, a healthy citrus grove has the opportunity of being irrigated efficiently and of allowing water savings for many years to come.

FERTIGATION

It is important to apply soluble fertilizers through the irrigation system (i.e. to fertigate) at the beginning of the season. Especially in the first year of conversion, it encourages root growth within the wet strip of the dripline.

CONVERSION TIMING

The best time to convert to drip irrigation is normally immediately after harvesting. This gives plants time to adapt to the new system before the beginning of summer and without fruit to feed.

SUGGESTIONS

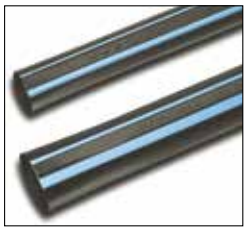
The following tips will improve the timing and quality of converting citrus groves from sprinkler irrigation to drip irrigation:

1. Schedule more frequent irrigations, especially in the first year and use soil moisture monitoring devices.
2. Apply a slight excess of irrigation, still in the first year, to maximise lateral diffusion and possible percolation of the accumulated salts.
3. Adopt a regular fertigation schedule.

OUR EXPERIENCE, OUR PRODUCTS

Toro has successfully been creating drip irrigation systems all over the world since the 1990s. After carrying out numerous experimental campaigns, Toro offers farmers three products for irrigating citrus fruits:

Aqua-Traxx® PBX: this is the Toro drip tape which ensures the highest performance on the market, with excellent uniformity of distribution and extraordinary quality;



Aqua-Traxx® FlowControl™: it is the only drip tape capable of regulating the flow, allowing an even better delivery uniformity wherever you decide to farm. FlowControl™ means even more uniform crop and higher yields.

Neptune PC AS: is the Pressure Compensating Anti-Siphon dripline by Toro which ensures an extraordinary resistance to clogging and excellent emission uniformity in the most challenging topographical conditions, especially on undulating terrains.

AQUA-TRAXX® PBX - Diameter 16 mm

Slope 0% - Emission Uniformity (EU) 90%

Code	Emitter Flow rate @ 0.7 bar	Emitter spacing	Maximum lengths in metres @ 0.7 bar
RA5xx0867-yyy		20 cm	133
RA5xx1245-yyy	1.14 l/h	30 cm	173
RA5xx1634-yyy		40 cm	208
RA5xx0851-yyy		20 cm	161
RA5xx1234-yyy	0.87 l/h	30 cm	209
RA5xx1625-yyy		40 cm	252

AQUA-TRAXX® PBX - Diameter 22 mm

Slope 0% - Emission Uniformity (EU) 90%

Code	Emitter Flow rate @ 0.7 bar	Emitter spacing	Maximum lengths in metres @ 0.7 bar
RA7xx0867-yyy		20 cm	237
RA7xx1245-yyy	1.14 l/h	30 cm	307
RA7xx1634-yyy		40 cm	368
RA7xx0851-yyy		20 cm	287
RA7xx1234-yyy	0.87 l/h	30 cm	372
RA7xx1625-yyy		40 cm	426

Aqua-Traxx® PBX is also available in other models. Request further information.

AQUA-TRAXX® PBX:

- 20, 30, 40cm spacings
- 10, 12, 15 mil thicknesses;
- 16mm (5/8") and 22mm (7/8") diameters
- Drippers 1.14 / 0.87 l/h at 0.7 bar

AQUA-TRAXX® FLOWCONTROL™

- 20, 30, 40cm spacings
- 10, 12, 15 mil thicknesses;
- 16mm (5/8") and 22mm (7/8") diameters
- Drippers 1.01 l/h at 0.7 bar

AQUA-TRAXX® FLOWCONTROL™ Diameter 16 mm

Slope 0% - Emission Uniformity (EU) 90%

Code	Emitter Flow rate @ 0.7 bar	Emitter spacing	Maximum lengths in metres @ 0.7 bar
EAFC5xx0867-yyy		20 cm	148
EAFC5xx1245-yyy	1.01 l/h	30 cm	194
EAFC5xx1634-yyy		40 cm	230

AQUA-TRAXX® FLOWCONTROL™ Diameter 22 mm

Slope 0% - Emission Uniformity (EU) 90%

Code	Emitter Flow rate @ 0.7 bar	Emitter spacing	Maximum lengths in metres @ 0.7 bar
EAFC7xx0867-yyy		20 cm	261
EAFC7xx1245-yyy	1.01 l/h	30 cm	336
EAFC7xx1634-yyy		40 cm	404

Aqua-Traxx® FlowControl™ is also available in other models. Request further information.

NEPTUNE PC:

- 2 versions: Anti-Siphon (AS) and No-Drain (ND)
- Diameter 16 mm, thickness 0.9 / 1.0 / 1.1 mm;
- Diameter 20 mm, thickness 0.9 / 1.0 / 1.2 mm;
- 4 Pressure-compensating Drippers: 1.2 / 1.6 / 2.4 / 3.8 l/h between 0.5 and 3.5 bar;
- Spacing from 20 cm.

NEPTUNE PC - AS and ND - Diameter 16 mm

Slope 0%

Code	Emitter Flow rate between 0.5 and 3.5 bar	Emitter spacing	Maximum lengths in metres @ 1.0 bar	@ 1.5 bar	@ 2.0 bar	@ 3.0 bar	@ 3.5 bar
PPx16xx2012		20 cm	72	90	105	122	129
PPx16xx3012	1.2 l/h	30 cm	98	125	144	172	183
PPx16xx4012		40 cm	126	161	185	221	236
PPx16xx3016		30 cm	92	118	136	162	173
PPx16xx4016	1.6 l/h	40 cm	115	147	169	203	216
PPx16xx6016		60 cm	155	198	229	274	292
PPx16xx4024		40 cm	88	113	130	155	166
PPx16xx6024	2.4 l/h	60 cm	119	152	176	211	224
PPx16xx8024		80 cm	146	187	216	259	276
PPx16xx4038		40 cm	66	84	97	115	123
PPx16xx6038	3.8 l/h	60 cm	89	113	131	157	167
PPx16xx8038		80 cm	109	140	161	193	206

NEPTUNE PC - AS and ND - Diameter 20 mm

Slope 0%

Code	Emitter Flow rate between 0.5 and 3.5 bar	Emitter spacing	Maximum lengths in metres @ 1.0 bar	@ 1.5 bar	@ 2.0 bar	@ 3.0 bar	@ 3.5 bar
PPx20xx2012		20 cm	119	151	170	207	212
PPx20xx3012	1.2 l/h	30 cm	168	213	245	293	312
PPx20xx4012		40 cm	210	267	309	368	392
PPx20xx3016		30 cm	135	172	198	237	252
PPx20xx4016	1.6 l/h	40 cm	169	216	249	298	317
PPx20xx6016		60 cm	230	294	339	407	433
PPx20xx4024		40 cm	130	166	191	228	243
PPx20xx6024	2.4 l/h	60 cm	177	226	261	312	332
PPx20xx8024		80 cm	219	280	323	386	412
PPx20xx4038		40 cm	97	123	142	170	181
PPx20xx6038	3.8 l/h	60 cm	132	168	194	232	247
PPx20xx8038		80 cm	163	208	240	287	306

Neptune PC is also available in other models. Request further information.

TESTIMONIALS

Mr Mohamad Ali Nahouli
AgriNahouli Farms
South Lebanon

We use Toro driplines on our main commercial farms in South Lebanon. We have been using Toro products for over a decade, having previously tried other brands.
What we have noticed about Toro's driplines is the high precision and uniformity of the flow, which result in clear savings in energy and fertiliser.
Year after year, we are increasingly confident in installing Toro products in our new citrus and banana plantations.

Gabriel Martinez
Agricultural Engineer at Novedades Agrícolas, Agroblue,
Aromas de la Huerta and Unión hidráulica
Spain

Oranges and tangerines are the most cultivated citrus fruits. Citrus fruits have been grown in Valencia and Castellón for more than 150 years, and drip irrigation have been used for 30-40 years.
We have been using Toro products for many years, first DRIP-IN, then Blueline and now Neptune PC. Irrigation systems have changed over the years, decreasing the spacing. Now we use a 50 cm spacing with 1.6 l/h or 2.2 l/h drippers. We are very satisfied with Toro's Neptune PC, it adapts perfectly to our needs.

Giovanni Molinaro
Molinaro Farm
Lamezia Terme, Catanzaro
Italy

We have been growing citrus fruits for over 3 generations, we have multiple varieties of oranges and clementines, ranging from September to the end of May, over an area of over 150 ha. We've been using Toro's dripline for 3 years: Neptune PC. Our system is a sub-irrigation one, with a spacing of 40 cm and a flow rate of 1.6 L/h, since our soils are very sandy.
I recommend the use of the Toro Neptune PC dripline to all citrus growers, both for the excellent product quality and for the greater water and economic efficiency.

TORO®

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