SELECTING THE RIGHT IRRIGATION EQUIPMENT FOR DIFFERENT TYPES OF CROPS

/ QUICK GUIDE

November 2021
v1.0

CONTENTS

INTRODUCTION

Dear Reader,

This booklet summarizes our recommendations for selecting Netafim™ irrigation equipment according to different crops. It is intended to assist Netafim™ sales executives to prepare themselves for meeting with customers and for Netafim™ personnel to enhance their professional knowledge. The booklet is divided into four major groups: field crops, orchards, open field vegetables and protected crops. For every group, we provide general guidelines in the Introduction, followed by a detailed table of the different types of equipment by crop or group of crops. The final table offers details on all the irrigation solutions offered by Netafim™ for the different groups of crops.

NOTE

The recommendations are general in nature, but they direct users towards the optimal solution for each crop. There might be other suitable alternatives. For details on specific guidelines, please contact a Netafim™ expert in your area.

INTRODUCTION (continued)

Questions to address when choosing drip irrigation

In determining the correct match between drip irrigation equipment and the different crops, it is important to consider the following information:

1. Will the equipment be used seasonally or multi-seasonally? (according to the grower's operative/economic considerations)

2. Accordingly, is the equipment thick-walled or thin-walled (based on working-pressure range, cost, and energy consumption).

3. Is the equipment pressure-compensated or non-pressure compensated? This will be based on hydraulic considerations.

4. How many laterals are needed per rows of plants?

5. According to plant population within a row and soil type – what is the correct dripper spacing?

6. Based on the answers to the previous questions and the cost of the equipment – which type of drippers should be used?

NOTE

If the grower has a clear view of his future cropping system (rotational crops) or permanent crops/orchards;
If he wants to avoid labor-intensive dripline installation and retrieval, he might use sub-surface drip irrigation (SDI).

INTRODUCTION (continued)

Netafim™ drippers and dripperlines

Netafim™ has a wide portfolio of drippers (online) and dripperlines (integral) that covers a wide range of crops and applications.

Our drip portfolio is divided into two main categories, pressure compensated drippers and dripperlines (PC), and non pressure compensated drippers, and dripperlines (NPC).

Each main dripperline category is divided into three sub-categories, each covers different uses or applications.

The sub-categories are:

Thin Walled Dripperlines (TWD) with wall thickness equal to or smaller than 0.39 mm.

Medium Walled Dripperlines (MWD) with wall thickness between 0.4 mm (included) and 0.89 mm (included).

Heavy Walled Dripperlines (HWD) with wall thickness equal to or more than 0.9 mm.

Pressure compensated drippers and dripperlines may also include additional features:

- Anti Siphon mechanism; AS™
- Non Leakage mechanism; CNL™
- Non Leakage mechanism; High opening pressure; HCNL™
- Anti Siphon with eXtra Root Resistance; ASXR™

Select the required additional features according to the crop and the application the dripper/ dripperline is intended to serve.

INTRODUCTION (continued)

Additional features - description:

AS: The Anti Siphon mechanism blocks contaminants from being drawn into the dripper from the outside, making it a vital addition to drippelines installed below the soil surface, i.e. sub surface drip irrigation (SDI).

CNL: Pressure-Compensated Non-Leakage is an anti-drain mechanism. When the pressure in the pipes drops (after valves shut off at the end of an irrigation cycle), the CNL mechanism closes the water passage, leaving pipes full of water and ready for the next cycle. CNL is ideal for pulse irrigation (irrigation in short frequent cycles) in greenhouses, nurseries, and fruit trees.

HCNL: Also called High-level Anti-Drain, HCNL is an anti-drain mechanism, similar to the CNL, but with higher opening pressure. This mechanism provides two main benefits:

1. Allows installation of non-leakage systems in areas with steeper slopes, thereby improving system efficiency, and reducing the number of DNLs (Dripperline Non Leakage Valves).
2. Maintains a higher pressure in the dripperlines used in pulse irrigation, hence enables mixing and circulating water and fertilizers in the system prior to an irrigation event. This makes it ideal for pulse irrigation in greenhouses, nurseries, and fruit trees.

ASXR (Anti Siphon with eXtra Root Resistance): reduces significantly the risk of roots penetrating and clogging the drippers by incorporating copper oxide that inhibits root growth inside the dripper. The copper formulation is mixed in the dripper cover to offer a long-lasting effect throughout the dripperline's life. ASXR is available in both Uniram™ and DripNet PC™. Uniram™ also includes a physical root barrier.

INTRODUCTION (continued)

Online PC drippers
- PC dripper
- PCJ dripper
- PCJ HF dripper

Online NPC drippers
- Button dripper
- Pot dripper
- Landline
- Leachline A

Integral PC dripperlines
- Uniram™
- DripNet PC™
- Techline™
- TechNet™

Integral NPC dripperlines
- Aries™
- Typhoon™ Plus
- Streamline™ Plus
- Micro drip

Other drippers
- CapinNet™
- Arrow dripper

Netafim™ dripper and dripperline portfolio mapping

Netafim™ offering for row crops
- Uniram™ AS
- Uniram™ RC
- Dripnet PC™
- Dripnet PC™ AS
- Aries™ HWD
- Aries™ MWD
- Aries™ TWD
- Typhoon™ Plus
- Streamline™ Plus

Netafim™ offering for orchards
- Uniram™ AS
- Uniram™ CNL
- Uniram™ HCNL
- Uniram™ AS XR
- Uniwine™
- Dripnet PC™ AS
- Aries™ HWD
- Online drippers

Netafim™ offering for protected crops
- Uniram™ CNL
- Uniram™ HCNL
- Dripnet PC™
- Aries™ HWD
- Aries™ MWD
- Online drippers
- Spiders and assemblies

Netafim™ offering for landscape
- Unitechline™ AS
- Techline™ CV
- Bioline™
- Technet™
- Technet™ AS
- Landline™
- Techflow Junior™

INTRODUCTION (continued)

Segment
- Open field
- Orchards
- Protected crops

Application
- Irrigation
- Cooling
- Humidification
- Germination
- Rooting
- Frost mitigation
- Leaves and dust cleaning

Coverage type
- Up to 5m X 5m
- Up to 7m X 7m
- Up to 10m X 10m
- Up to 10m X 12m
- Up to 12m X 12m
- Up to 12m X 13m
- Up to 18m X 18m
- Up to 20m X 20m
- Up to 18m X 18m
- Strip
- Localized

INTRODUCTION (continued)

Netafim™ sprinklers, micro-sprinklers and emitters

Netafim™ offers a wide range of sprinklers, micro-sprinklers and emitters for various applications. We divide our sprinklers to three main segments: Open field, Orchards and Protected crops. In each segment, there are different needs and requirements.

In open field, the main sprinkler applications are soil preparation, germination, and irrigation of vegetable row crops such as potatoes, carrots, onion, garlic, lettuce, broccoli etc.

In orchards, we use micro-sprinklers and sprinklers for several applications, such as under tree irrigation, frost mitigation, cooling, humidification of orchards and leaves and dust cleaning.

In protected crops such as greenhouses, tunnels, net-houses and open nurseries, we use micro-sprinklers and micro-emitters with upside-down installation for soil preparation, irrigation, germination, cooling, humidification and rooting.

In any segment we must carefully select the right product according to the required application in order to achieve the highest performance and optimal design.

Open Field

Sprinkler irrigation in open field is adaptable to most crops, soils and topographical characteristics. However, a careful consideration of the design must be carried out in order to obtain an economical system that provides efficient and uniform water distribution over the irrigated area to achieve high crop uniformity. There are several factors, that should be considered before we select a sprinkler: precipitation rate, water distribution uniformity, evaporation loss during sprinkler irrigation, soil infiltration rate, maximum lateral length, head loss in the riser tube and sprinkler water trajectory. It is very important to consider also the wind conditions in the irrigated area.

INTRODUCTION (continued)

Only when considering all these factors can you select the best sprinkler for your field.

Netafim™ offers a wide sprinkler portfolio for open field irrigation, including sprinkler stands and complementary products. In general, you can select the product according to the following spacing patterns: (*Note before selecting a product, check the water distribution uniformity - CU/DU/SC for each case.

- GyroNet™ Turbo - up to 7 X 7m
- MegaNet™ - up to 10 X 10m
- LWP™ 2450 - up to 10 X 10m
- D-Net™ 8550 - up to 12 X 13m
- D-Net™ 9575 - up to 15 X 18m
- HWP™ 2475 - up to 20 X 20m

Orchards

Netafim™ micro-sprinklers have been uniquely designed for orchard installations, and are the ideal solution for under tree irrigation, frost mitigation and cooling of orchards. The versatile Netafim™ line of micro-sprinklers and stands, covers a broad scope of flow requirements and wetted diameter requirements, thereby simplifying the design process. Whether you are designing a new application or retrofitting an existing system, our micro-sprinklers offer highly reliable solutions for all your needs. We have the right product for the required application:

Irrigation by one micro-sprinkler per tree can be achieved by the SuperNet™, GyroNet™ or VibroNet™ SD. For changing topography or longer laterals, SuperNet™ - a flow-regulated micro-spinkler- is the product of choice.

Strip irrigation (rectangular coverage), can be achieved by SuperNet™ or GyroNet™.

Frost mitigation or cooling is accomplishedby applying a certain amount of water above the canopy. Netafim™ offers several solutions that must be selected meticulously according to tree type, size and spacings. The relevant products are: SuperNet™, GyroNet™, MegaNet™ and the Pulsar™, a unique solution that provides water with high water and energy efficiency, specially designed to save around 50% of the water.

INTRODUCTION (continued)

Protected crops

Netafim™ micro-sprinklers and micro-emitters have been uniquely designed for upside-down installation, and are the ideal solution for irrigation, cooling and humidification of protected crops in greenhouses, tunnels, nurseries and net-houses. Our products supply unprecedented watering uniformity in both standard full overlap installation and with our well-established "micro-sprinkler strip".

The versatile Netafim™ line of micro-sprinklers and micro-emitters covers a broad scope of applications, simplifying the design process. Whether you are designing a new application or retrofitting an existing system, our micro-sprinklers and micro-emitters offer highly reliable solutions for all your needs.

We have the right product for the required application:

- Full coverage upside-down irrigation by the SpinNet™
- Bay irrigation (Single line or double line irrigation) - SpinNet™ and SpinNet™ SD
- Germination: VibroNet™
- Rooting by CoolNet Pro™
- Cooling and Humidification by CoolNet Pro™

FIELD CROPS

FIELD CROPS

Field crops are generally sown (a minority are planted as seedlings) in several rows in a bed or by "drill seeding" across the field for relatively high-density plants. In most cases, these crops are grown in heavy soil and have deep roots. They typically bring low financial return per unit of land, but are grown on large plots.

Drip Solutions for Field Crops

Crop	Bed width (center to center, m)	Number of laterals per 2 crop rows	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (usually seasonal) 6-15 mil	
					Pressure-compensated	Non-pressure-compensated*	Pressure-compensated	Non-pressure-compensated*
Row crops – up to 2 rows/bed, deep root zone: cotton, corn, sorghum, industrial tomatoes, sunflowers, chickpeas, etc.	1.5-1.9	1	40-50	0.4-1.6	Uniram™ DripNet™	Aries™	DripNet™	Typhoon™ Plus; Streamline™; or Aries™ with low-quality water
Row crops – more than 2 rows/bed or set spacing without beds: peanuts, sugar beets, rice, peas, beans	0.3-0.96 between rows		30-50					

*Relatively short laterals

NOTES

a. With subsurface, pressure-compensated drip irrigation, use AS equipment. With thin-walled equipment, up to a maximum thickness of 15 mil, it is recommended to use dripperlines with a flap.

b. Determine the diameter of the laterals (the following recommendations are generic and the final pipe diameter and thickness should be determined based on the field hydraulic considerations):
- Short laterals (up to 200 m) - consider using 12-16-20 mm.
- Long laterals (over 200 m) consider using 20-32 mm.

In light soil and/or germination with drip irrigation, reduce the space between drippers.

c. According to Netafim™ definitions:
Heavy Walled Dripperlines (HWD) are dripperlines with wall thickness equal to or more than 0.9 mm;
Medium Walled Dripperlines (MWD) are dripperlines with wall thickness between 0.4 mm and 0.89 mm (included).
Thin Walled Dripperlines (TWD) are dripperlines with wall thickness equal to or smaller than 0.39 mm.

FIELD CROPS (continued)

Sprinkling Solutions for Field Crops

Crop Group	Application	Sprinkler type	Actual flow [l/h]	Nominal pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Field crops	Irrigation Germination Soil cultivation	HWP™ 2475 Rectangular installation	2150	3.5	18	18	6.6	100
			2735	3.5	18	18	8.4	
			3060	3.5	18	18	9.4	
			2150	3.5	20	20	5.4	
			2735	3.5	20	20	6.8	
			3060	3.5	20	20	7.7	
Field crops	Irrigation Germination Soil cultivation	D-Net™ 9575	1200	3	12	15	6.7	100
			1400	3	12	15	7.9	
			1600	3	12	15	8.9	
			1800	3	12	15	10.1	
			2000	3	12	15	11.1	
			1400	3	12	16	7.4	
			1600	3	12	16	8.3	
			1800	3	12	16	9.4	
			2000	3	12	16	10.4	
			1400	3	15	15	6.3	
			1600	3	15	15	7.1	

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%CU | > 92% | > 88% and < 92%

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FIELD CROPS (continued)

Crop Group	Application	Sprinkler type	Actual flow [l/h]	Nominal pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Field crops	Irrigation Germination Soil cultivation	D-Net™ 9575	1800	3	12	15	10.1	
			2000	3	12	15	11.1	
			1400	3	12	16	7.4	
			1600	3	12	16	8.3	
			1800	3	12	16	9.4	
			2000	3	12	16	10.4	
			1400	3	15	15	6.3	
			1600	3	15	15	7.1	
			1800	3	15	15	7.5	
			1400	3	15	18	6.7	
			1600	3.5	15	18	6.4	
			1800	3	15	18	5.2	
Field crops	Irrigation Germination Soil cultivation	D-Net™ 8550	510	2.5	10	12	4.4	100
			580	2.5	10	12	4.9	
			680	2.5	10	12	5.7	
			810	2.5	10	12	6.8	
			940	2.5	10	12	7.9	

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%CU | > 92% | > 88% and < 92%

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FIELD CROPS (continued)

Crop Group	Application	Sprinkler type	Actual flow [l/h]	Nominal pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Field crops	Irrigation Germination Soil cultivation	MegaNet™	510	2.5	12	12	3.7	
			580	2.5	12	12	4	
			680	2.5	12	12	4.7	
			810	2.5	12	12	5.6	
			940	2.5	12	12	6.5	
			1135	2.5	10	15	7.6	
			1275	2.5	10	15	8.5	
Field crops	Irrigation Germination Soil cultivation	MegaNet™	250	2.5	8	8	4.4	100

%CU | > 92% | > 88% and < 92%

NOTE

Christiansen Coefficient of Uniformity (%CU)

The %CU is a measurement of uniformity, expressed as the average rate (%) of deviation from the overall average application. A perfectly uniform application is represented by a CU of 100%.

%CU for open field sprinkler irrigation

92% or higher	Excellent uniformity
88% to 92%	Very good uniformity
86% to 88%	Good uniformity
Lower than 86%	Acceptable for certain low-value crops only

OPEN FIELD VEGETABLES

OPEN FIELD VEGETABLES

Open field vegetables are sown or planted as seedlings, are crops planted in multiple rows in relatively high-density, with high financial returns. They are grown in various soils, usually in beds or

Drip Solutions for Open Field Vegetables

Crop	Bed width (center to center, m)	Number of laterals per 2 crop rows	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (usually seasonal) 6-15 mil	
					Pressure-	Non-pressure-	Pressure-	Non-pressure-
Bed crops – 2 rows or more per bed – high plant stand, shallow root system – onion, carrot, garlic, lettuce, beet, strawberry, parsley, dill, etc.	1.5-1.93	1 lateral/2 rows	Light soil: 20-30 Heavy soil: 30-40	0.4-1.6	DripNet™	Aries™	DripNet™	Typhoon™ Plus Streamline™
Bed crops – up to 2 rows of plants per bed, relatively low plant stand for open field vegetables, deep root system – eggplant, tomato, cabbage, cauliflower, broccoli, artichoke, asparagus, pepper, watermelon, melon, squash, celery, pumpkin			Light soil: 25-40 Heavy soil: 40-50		Uniram™ DripNet™			Typhoon™ Plus; Streamline™; or Aries™ with low-quality water
Ridge crops – 1 row per ridge – high plant stand – root system limited to ridge – potato, sweet potato, etc. The equipment is usually shallow subsurface.	0.75-0.90 between ridges	1 lateral/ridge			DripNet™			

NOTES

a. With subsurface, pressure-compensated drip irrigation, use AS equipment. With thin-walled equipment, up to a maximum thickness of 15 mil, it is recommended to use dripperlines with a flap.

b. Determine the diameter of the laterals (the following recommendations are generic and the final pipe diameter and thickness should be determined based on the field hydraulic considerations):

- Short laterals (up to 200 m) - consider using 12-16-20 mm.
- Long laterals (over 200 m) consider using 20-32 mm.According to Netafim™ definitions:

OPEN FIELD VEGETABLES (continued)

Sprinkling Solutions for Open Field

Crop Group	Application	Sprinkler type	Actual flow [l/h]	Nominal pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Field crops	Irrigation Germination Soil cultivation	HWP™ 2475 Rectangular installation	2150	3.5	18	18	6.6	100
			2735	3.5	18	18	8.4	
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Field crops	Irrigation Germination Soil cultivation	D-Net™ 9575	1200	3	12	15	6.7	100
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			2000	3	12	15	11.1	
			1400	3	12	16	7.4	
			1600	3	12	16	8.3	
			1800	3	12	16	9.4	
			2000	3	12	16	10.4	
			1400	3	15	15	6.3	
			1600	3	15	15	7.1	

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%CU | > 92% | > 88% and < 92% |

OPEN FIELD VEGETABLES (continued)

Sprinkling Solutions for Open Field Vegetables (continued)

Crop Group	Application	Sprinkler type	Actual flow [l/h]	Nominal pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Field crops	Irrigation Germination Soil cultivation	D-Net™ 9575	1800	3	15	15	7.5	100
			1400	3	15	18	6.7	
			1600	3.5	15	18	6.4	
			1800	3	15	18	5.2	
Field crops	Irrigation Germination Soil cultivation	D-Net™ 8550	510	2.5	10	12	4.4	100
			580	2.5	10	12	4.9	
			680	2.5	10	12	5.7	
			810	2.5	10	12	6.8	
			940	2.5	10	12	7.9	
			510	2.5	12	12	3.7	
			580	2.5	12	12	4	
			680	2.5	12	12	4.7	
			810	2.5	12	12	5.6	
			940	2.5	12	12	6.5	
			1135	2.5	10	15	7.6	
			1275	2.5	10	15	8.5	

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OPEN FIELD VEGETABLES (continued)

Sprinkling Solutions for Open Field Vegetables (continued)

Crop Group	Application	Sprinkler type	Actual flow [l/h]	Nominal pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Field crops	Irrigation Germination Soil cultivation	MegaNet™	250	2.5	8	8	4.4	100
			350	2.5	9	9	3.9	
			500	3	9	9	6.2	
			600	3	9	9	7.5	
			350	3	10	10	3.6	
			500	3	10	10	5	
Field crops	Irrigation Germination Soil cultivation	GyroNet Turbo™	213	2.5	4	6	9	100

%CU | > 92% | > 88% and < 92% |

NOTE

Christiansen Coefficient of Uniformity (%CU)

The %CU is a measurement of uniformity, expressed as the average rate (%) of deviation from the overall average application. A perfectly uniform application is represented by a CU of 100%.

%CU for open field sprinkler irrigation

92% or higher	Excellent uniformity
88% to 92%	Very good uniformity
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Lower than 86%	Acceptable for certain low-value crops only

ORCHARDS

ORCHARDS

In the category of Orchard crops, bushes and trees are usually planted with large spacing between the plants and between the rows, on various soils. The cost component of the irrigation equipment, per area, is relatively low. The equipment is usually multi seasonal, with the option of sub-surface installation. The character of the root system varies and the irrigation equipment must match the sensitivity of the plants to extreme conditions.

Drip Solutions for Orchards

Crop	Plant spacing (m)	Number of laterals per row	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (temporary on-surface for first 2-3 years) 6-15 mil		Notes
					Pressure-compensated	Non-pressure-compensated*	Pressure-compensated	Non-pressure-compensated*	
Subtropical – relatively shallow root system, high sensitivity to water stress: avocado, mango, lychee, banana, coffee, tea	1.5-3.0 X 4.0-7.0	2-3	30-50	0.4-1.6	Uniram™ DripNet™	Aries™	DripNet™	Typhoon™ Plus; Streamline™; or Aries™ with low-quality water	
Deciduous – deep-rooted, with relatively low plant stand per group: apple, pear, peach, nectarine, cherry, apricot, almond, olive, pomegranate, etc.	1.5-6 X 5.0-7.0	1	50-75	1.0-2.3	Uniram™ DripNet™	Aries™	DripNet™	Typhoon™ Plus; Streamline™; or Aries™ with low-quality water	

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*Relatively short laterals

ORCHARDS (continued)

Drip Solutions for Orchards (continued)

Crop	Plant spacing (m)	Number of laterals per row	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (temporary on-surface for first 2-3 years) 6-15 mil		Notes
					Pressure-compensated	Non-pressure-compensated*	Pressure-compensated	Non-pressure-compensated*	
Grapevines	1.5 X 2.5-3.0	1	50-75	1.6-2.3	Uniram™ DripNet™	Aries™	DripNet™	Typhoon™ Plus; It is possible to introduce temporary on-surface equipment with Streamline™	Beginning with the second irrigation season, burying the permanent lateral is recommended. It can be buried between the rows.

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*Relatively short laterals

ORCHARDS (continued)

Drip Solutions for Orchards (continued)

Crop	Plant spacing (m)	Number of laterals per row	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (temporary on-surface for first 2-3 years) 6-15 mil		Notes
					Pressure-compensated	Non-pressure-compensated*	Pressure-compensated	Non-pressure-compensated*	
Dates	8-9 X 8-9	2 integral laterals for a continuous wetted strip or PE pipe with online drippers or integral dripperline in loops	50-100 continuous wetted strip 2-5 barb drippers per tree	2.3-3.5 in integral dripperlines 8-25 online drippers	Uniram™ PC/PCJ	Aries™	DripNet™	Typhoon™ Plus	Three drip irrigation methods: 1) integral drip irrigation along the rows; 2) integral loops around the trunk; 3) blind hosepipe with barb drippers next to the tree
Nuts – pecan, walnut, hazelnut	3-8 X 5-10	2-4	50-75	1.0-2.3	Uniram™	Aries™	DripNet™	Typhoon™ Plus	

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ORCHARDS (continued)

Drip Solutions for Orchards (continued)

Crop	Plant spacing (m)	Number of laterals per row	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (temporary on-surface for first 2-3 years) 6-15 mil		Notes
					Pressure-compensated	Non-pressure-compensated*	Pressure-compensated	Non-pressure-compensated*	
Berries – raspberries, blueberries	0.7-1.2 X 3.0	2	35-60	0.4-1.6	Uniram™	Aries™	DripNet™	Typhoon™ Plus	
Citrus	2.5-4 X 5-6	1-2	30-50	1.0-2.3	Uniram™ DripNet™	Aries™	DripNet™	Typhoon™ Plus Streamline™	In grapefruit and easy peelers, use of two laterals was accompanied by an increase in fruit size

*Relatively short laterals

NOTES

a. With subsurface, pressure-compensated drip irrigation, it is recommended to use AS dripperlines. With thin-walled subsurface equipment, up to a maximum thickness of 15 mil, it is recommended to use dripperlines with a flap.
b. In the transition of orchard irrigation from sprinklers to drip irrigation, it is necessary to add more laterals than customary in orchards grown with drip irrigation from the beginning, in order to increase the width of the wetted area.
c. Orchards can be irrigated with micro-sprinklers/emitters, one or two per tree (dates, citrus), taking into account the constraints of wind conditions, water quality and water infiltration into the soil.
d. In planting young trees in pots, the irrigation can be done also by integral dripperlines such as Uniram™ using a Uniram™ zipper/Uniram™ ring adapter.
e. The diameter of the laterals in short laterals should be 16-20 mm. The diameter of relatively long laterals for orchards should be 20-30 mm.

ORCHARDS (continued)

Sprinkling Solutions for Orchards

Crop Group	Application	Micro sprinkler type	Flow range [l/h]	Working pressure [bar]	Deflector type	Installation	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Orchards	Irrigation	SuperNet™	20, 30, 35, 40, 50, 58, 70, 90, 110	1.5-4	LR, LRD, SR, SRD	One per tree		20-30
			30, 35, 40		SSR			
			30, 35, 40, 50, 58, 70, 90		UD			Upside-down
			30, 35, 40, 50, 58, 70, 90		40, 58, 70, 90, 120			20-30
	Irrigation	GyroNet™	27, 40, 58, 70, 90, 120, 150, 200, 250, 300	1.7-2.5	LR, LRD, SR, SRD	One per tree		20-30
	Frost mitigation - Full coverage	MegaNet™	200-350	2.5		9m X 9m - 10m X 12m	minimum 3 mm/h	50 cm above the tops
	Frost mitigation - Localized coverage	GyroNet™	40,58	1.7-2.5		One per tree		
		SuperNet™	40,58	1.5-4				
	High efficiency frost mitigation	Pulsar™	8-30 (PCJ) + GyroNet™ head	2.5				
	High efficiency cooling and dust cleaning	Pulsar™	8-30 (PCJ) + GyroNet™ head	2.5				

PROTECTED CROPS

PROTECTED CROPS

Protected crops usually involve intensive cultivation, high input costs and high returns per unit of land. They include vegetables, flowers, different types of nurseries and a small number of orchard crops. Most of the growing is done indoors, in the soil and a minority on a soilless substrate in a variety of growing containers.

Drip Solutions for Protected Crops

Crop	Bed width (center to center, m)	Number of laterals per 2 crop rows	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (usually seasonal) 6-15 mil	
					Pressure-	Non-pressure-	Pressure-	Non-pressure-
Bed crops – up to 2 rows of sowing/planting per bed – tomato, eggplant, pepper, roses, cucumber, squash, melon, etc.	1.4-2.0	1 lateral/row	Light soil: 20-30 Heavy soil: 30-40	0.4-1.6	Uniram™ DripNet™	Aries™ Typhoon™ Plus	DripNet™	Typhoon™ Plus Streamline™
Bed crops – more than 2 rows of plants per bed – herbs, leafy crops, green ornamental stems, carnations, solidago, lisianthus, etc.	1.4-2.0	1 lateral/2rows of plants	Light soil: 20-30 Heavy soil: 30-40	0.4-1.6	Uniram™ DripNet™	Aries™ Typhoon™ Plus	DripNet™	Typhoon™ Plus Streamline™
Soilless substrate; varying widths, lengthwise growing containers – row crops: tomato, eggplant, cucumber, peppers, roses, etc.	1.4-2.0	Per every 20 cm width of the growing container – 1 lateral	15-20	0.4-1.6	Uniram™ DripNet™	Aries™ Typhoon™ Plus	DripNet™	Typhoon™ Plus Streamline™

continued on next page

*Relatively short laterals

PROTECTED CROPS (continued)

Drip Solutions for Protected Crops (continued)

Crop	Bed width (center to center, m)	Number of laterals per 2 crop rows	Dripper spacing (cm)	Range of dripper flow rate (l/h)	Thick-walled dripper lines (multi-seasonal) 20-47 mil		Thin-walled dripper lines (usually seasonal) 6-15 mil	
					Pressure-	Non-pressure-	Pressure-	Non-pressure-
Soilless substrates – grow bags: buckets, plant pots – different kinds of nurseries.	Buckets 1.4-2.0 Plant pots up to a few cm between rows on growing tables	Blind line per every 2 rows of plant pots	According to growing container volume: up to 3 liters – 1 dripper; 3-10 liters – 2 drippers; 10 liters – 4 drippers	1.0-2.0	PC and PCJ or an assembly with a main pressure-compensated dripper and arrow drippers or spikes at the end	Arrow drippers with or without a main barb dripper (plant pot dripper)		

*Relatively short laterals

NOTES

a. Because of the relatively short length of the laterals, for protected crops please consider using lateral diameters in the range of 12-16mm if the hydraulics of the system allows.
b. Because of the relatively low water holding capacity of the bedding in soilless substrates compared with soil, the drippers should be spaced closely with low flow rates.
c. In most cases, indoor equipment will be multi-seasonal.
d. In multi-pulse irrigation, use anti-drain equipment (CNL).
e. In pots/buckets – irrigation assemblies include a main dripper, and the option of additional micro-tubes with drip holders or arrow drippers at their ends. It is important to make sure that the output at the end of the micro-tube is no less that 1 liter/hour. In assemblies with many micro-tubes, make sure the length of the tubes is uniform and that they are placed at the same height as the pots in order to get uniform water output.

PROTECTED CROPS (continued)

Sprinkling Solutions for Protected Crops

Crop Group	Application	Micro sprinkler type	Flow range [l/h]	Working pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Protected crops	Irrigation Soil cultivation & cooling during establishment	SpinNet™ SR	50	2.5	3.5	3.5	4.3	Upside-down. Above 180 cm
Protected crops	Cooling during establishment & soil cultivation	SpinNet™ FLT	70	2.5	4	4	3.9	Upside-down. Above 180 cm
Protected crops	Cooling during establishment & soil cultivation	SpinNet™ SR / FLT	90	2.5	4-4.5	4	4.5-4.8	Upside-down. Above 180 cm
Protected crops	Irrigation Soil cultivation & cooling during establishment	SpinNet™ SR	120	2.5	4-4.5	4	5.4	Upside-down. Above 180 cm
Protected crops	Irrigation Soil cultivation & cooling during establishment	SpinNet™ FLT	120	2.5	4	4	6-6.8	Upside-down. Above 180 cm
Protected crops	Single-line irrigation & cooling	SpinNet™ SD LR	160/090	2.5	0.6-0.8	6-6.5	23	Upside-down. Above 150 cm

%CU | > 92% | > 88% and < 92%

PROTECTED CROPS (continued)

Sprinkling Solutions for Protected Crops (continued)

Crop Group	Application	Micro sprinkler type	Flow range [l/h]	Working pressure [bar]	Spacing between heads [m]	Spacing between laterals [m]	Average precipitation rate [mm/h]	Sprinkler height above ground [cm]
Protected crops	Single-line irrigation & cooling	SpinNet™ SD LR	160/070	2.5	0.6-0.8	6-6.5	20.4	Upside-down. Above 180 cm
Protected crops	Single-line irrigation & cooling	SpinNet™ SD LR	160/090	2.5	0.6-1.0	7	21.4-13.6	Upside-down. 180-150 cm
Protected crops (nurseries)	Germination & table irrigation	Pulsar™	40, 50	3.0	1.8	1.8	10.2-12.7	Upside-down. 90-180 cm
Protected crops (nurseries)	Cooling & humidification	CoolNet Pro™	5.5, 7.5, 14.0	4.0	3	3	-	Uniform height, as high as possible
Protected crops (nurseries)	Rooting	CoolNet Pro™	5.5, 7.5, 14.0	4.0	1.5	1.5	-	Upside-down. 150 cm

%CU | > 92% | > 88% and < 92%