



**SOLUTIONS**  
FOR **CROPS**

# FROST PROTECTION

**Fresh water** is a resource we all depend on. It is becoming scarce and we must learn how to use it more carefully. Adopting **new and better ways** to more **efficiently** use water is beneficial not only to ourselves, but to the environment in general.

We, at **NaanDanJain** offer you the best possible **frost protection solution** tailor made specifically for you.

**NAANDANJAIN**

A **JAIN IRRIGATION** COMPANY

## INTRODUCTION

The world around us is changing. Change has always been a part of this planet, but recently the rate at which change occurs has been accelerating. Extreme weather phenomena, such as tsunamis, earthquakes, heat waves, cold fronts and floods are becoming more and more common.

The natural and agricultural environment is highly affected by climate change. The leafing out, blooming, flowering, ripening of fruits, water balance and so on are all very susceptible to stress and severe damage as a result of the extreme weather.

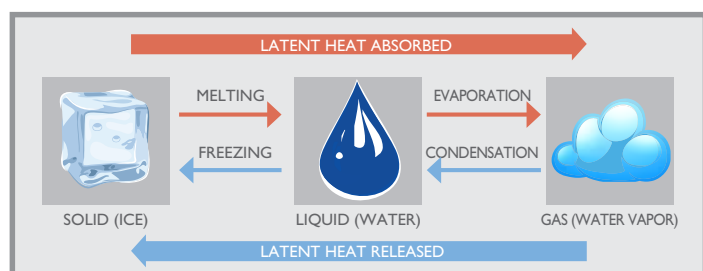
One of these extreme weather events is the drop of temperatures below  $0^{\circ}\text{C}$ , namely frost. When these drops in temperature occur out of season, the plants are ill-equipped to cope with it on the physiological level, and they suffer severe damage as a result.

There are two kinds of frost:

**Advection Frost (Windy Frost or Black Frost)** occurs when a cold air mass (cold front) moves into an area, bringing freezing temperatures. Wind speed is usually above 8 km/h. Possible protection against this kind of frost is very limited.

**Radiation Frost** occurs when, with a clear sky and calm winds, the temperature near the surface of the earth drops to below freezing point. As temperatures drop, the cold air flows downward to lower topographic areas. That is where most of the damage is seen. Efforts have been made to come up with a solution for this kind of frost; a way to alleviate the damage caused by the low temperatures. In order to do so, we utilize the same basic laws of nature that play an important role in creating the frost itself.

Many methods have been used to protect fields and plantations from frost, including smokers, wind machines, helicopters, the burning of tires and the use of sprinklers. Some methods have been more successful than others. The use of sprinklers was found most efficient in most cases.



## FROST PROTECTION BY SPRINKLER

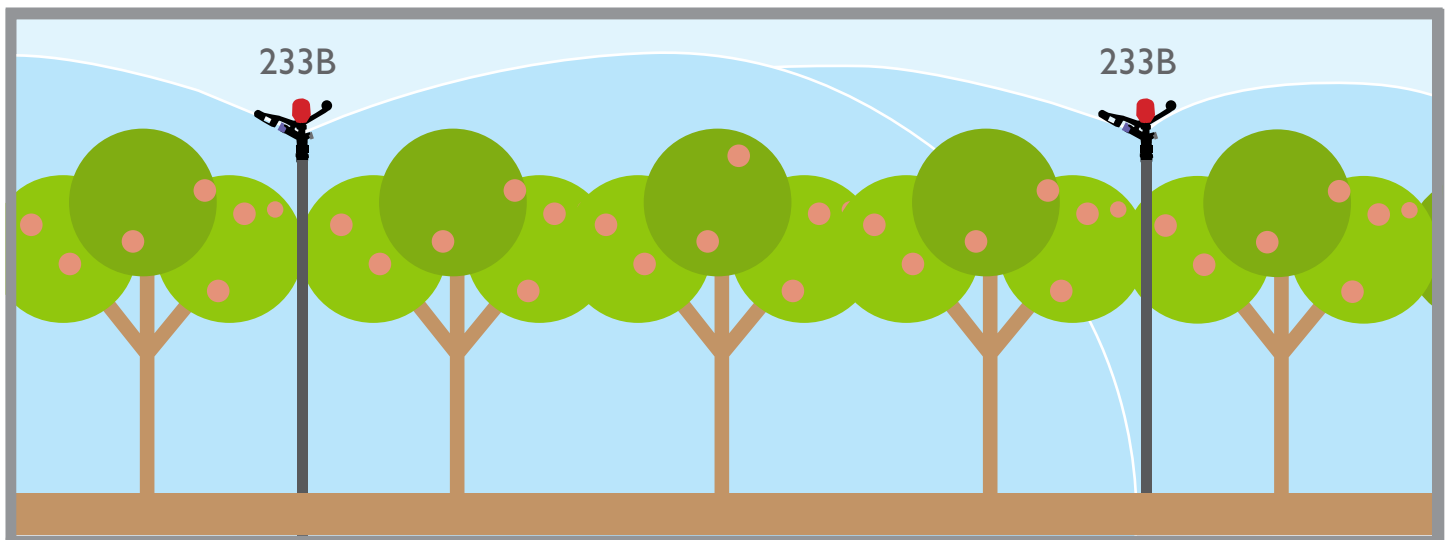
There are different ways to use sprinklers for frost protection, taking many factors into account. However, the same thermodynamic principles apply to all methods of irrigation:

A minimum application rate of 3.0 mm/h is required. This is enough to provide protection at temperatures as low as  $-3^{\circ}\text{C}$ . Another 0.5 mm/h is required for every additional degree, i.e. if the temperature is  $-4.0^{\circ}\text{C}$ , the minimum application rate will be 3.5 mm/h (35 m<sup>3</sup>/ha/hour).

### METHODS OF WATER APPLICATION



#### I. Overhead Full Cover



Overhead sprinkler irrigation is a very common practice in frost protection. Overhead irrigation provides excellent frost protection at temperatures of  $-7^{\circ}\text{C}$  and lower if the application rates are sufficient and the application is uniform. Drawbacks of this method are extensive water consumption; ice loading can cause branch damage; and root disease can be a problem in poorly drained soils. Water logging and soil erosion may also be a problem due to the large amount of water needed for overhead full cover frost protection.

Conventional overhead sprinkler systems use standard impact sprinklers to completely wet the plants and soil. Sprinkler distribution uniformity is important to prevent inadequate coverage, which might result in damage. In most cases, the sprinkler heads should be mounted at 30 cm or higher above the top of the plant canopy to prevent the plants from blocking the spray. For frost protection, specially designed springs are often used, which are protected by an enclosure to prevent the icing of the heads. In short, the conventional overhead full cover method, when applicable, provides excellent protection and is the most common and safest frost protection solution. Wildly used in open field crops, all kinds of orchards, blueberries and more



## NAANDANJAIN SOLUTIONS FOR OVERHEAD FULL COVER:



### 233 B - Impact Sprinkler

- High water distribution with spacing up to 20m.
- Integrate stream straightening for maximum range.
- Red cap protects drive spring and protects from frost damage.



### Super 10

- Flow rate: 360-670 l/h
- Upright installation.
- A compensated flow rate version is available
- Big droplets size (no mist)
- Overhead and overlap installation



### Super 10 LA

- Flow rate: 360-850 l/h
- Upright installation.
- 2 Different low angles 10° and 14°
- Big droplets size (no mist)
- Overhead target installation



### Mamkad 16

- Flow rate: 135-270 l/h
- Upright installation.
- A compensated flow rate version is available
- Big droplets size (no mist)
- Overhead and overlap installation

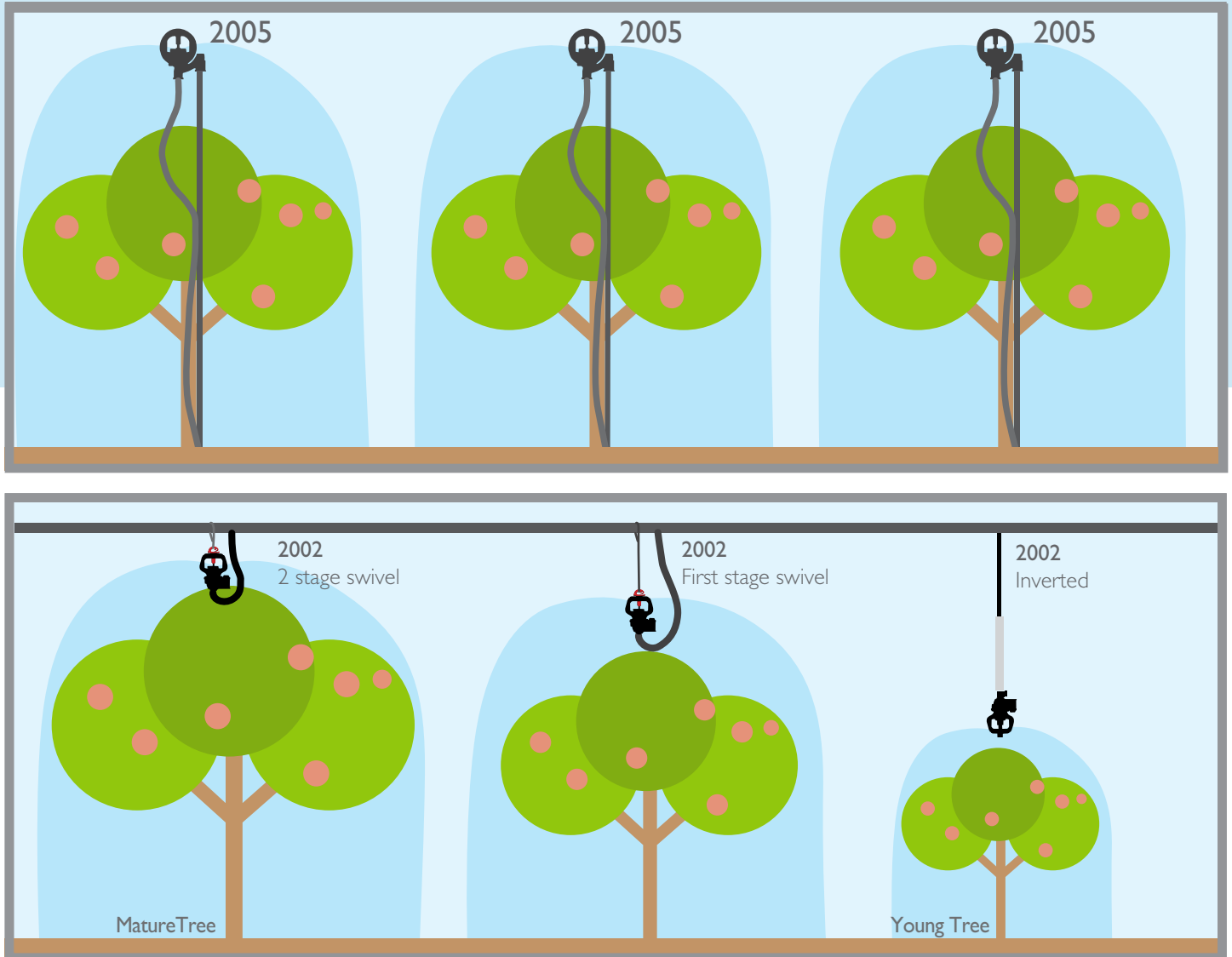


### Mamkad 16 LA

- Flow rate: 180-320 l/h
- Upright installation.
- Big droplets size (no mist)
- Overhead target installation



## 2. Targeted Micro Sprinklers



Targeted micro sprinklers spray the water directly onto the plants, with smaller amounts of water falling between plant rows. Usually a single micro-sprinkler is positioned above a single tree. A big advantage of using targeted sprinklers is that they commonly have much lower flow rates compared to conventional sprinklers. In other cases, like some of the fruit wall crops, an over lapping spacing between the micros sprinklers is applied and a continuous wetting zone is achieved along the relatively narrow row of trees. Giving perfect targeted protection. Needless to say, this saves large amounts of water and consequently mitigates the disadvantages of the conventional impact sprinklers and saves money.

One of the advantages of targeted micro-sprinklers is their ability to protect larger areas with a given amount of water. On the other hand, one of the limiting factors of this kind of frost protection is the possibility of water freezing inside the narrow tubes leading up to the emitters. The flow velocity will determine the point of freezing.

When planning a frost protection system using the targeted method, this should be taken into account and a sufficient flow velocity should be ensured. The same principle applies to the "Strip" method presented below.



### 2002 AquaSmart

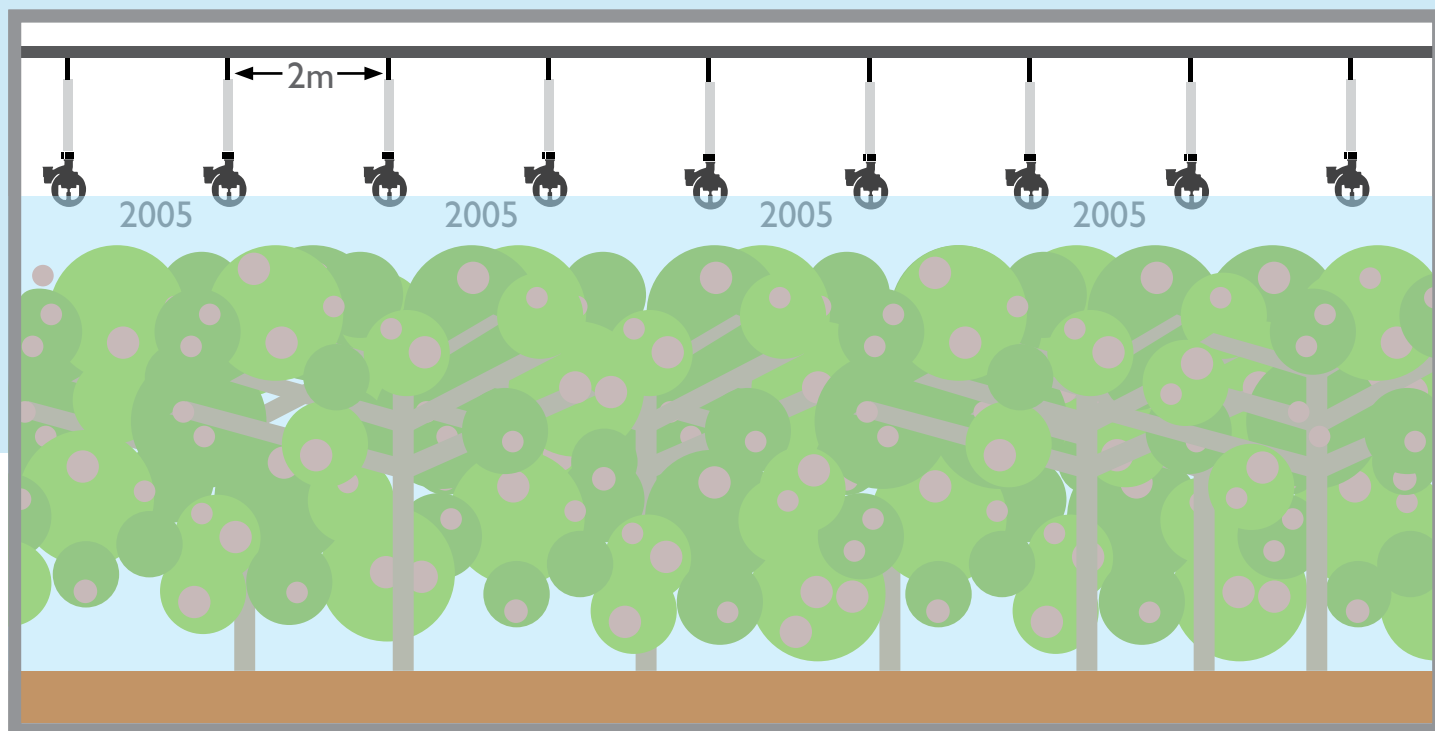
- Flow rate: 20-95 l/h
- Upright installation.
- Upside down installation
- Big droplets size (no mist)
- Overhead target installation



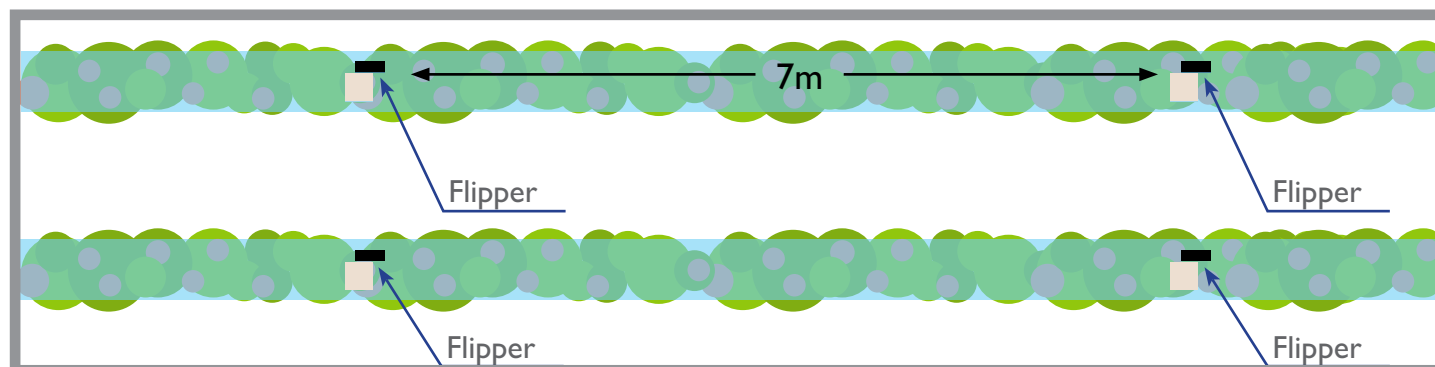
### 2005 AquaMaster

- Flow rate: 35-300 l/h
- Upright installation.
- Upside down installation
- Big droplets size (no mist)
- Overhead target installation

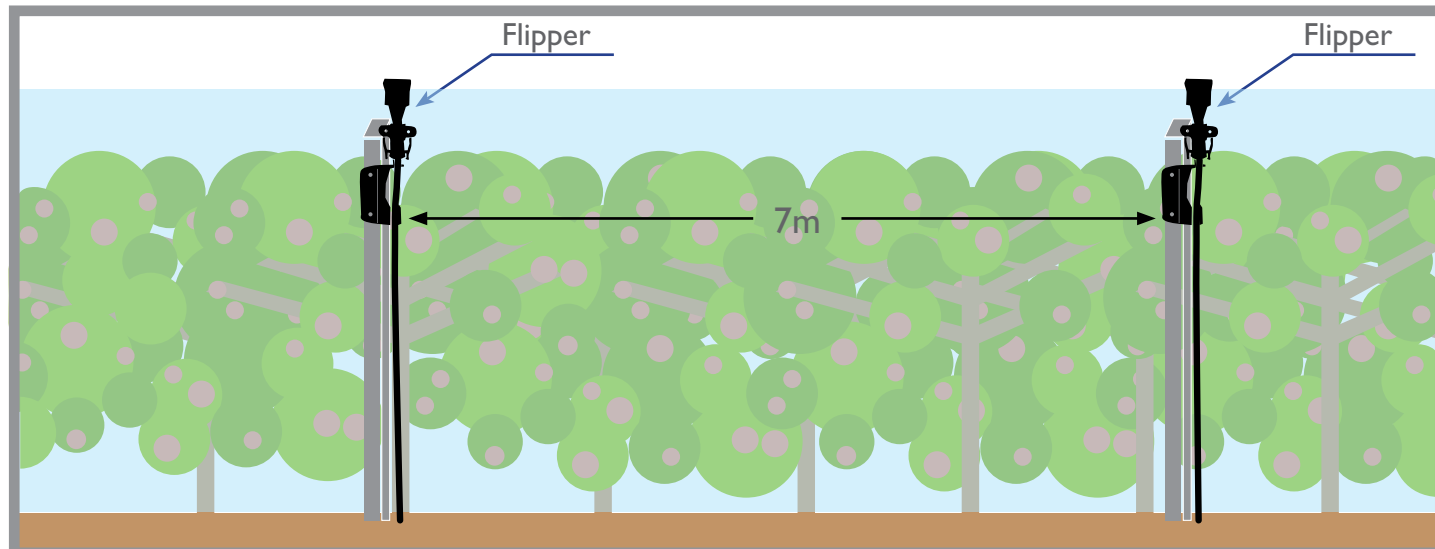
### 3. Strip Method - The latest, most adaptive frost protection solution is strip



TOP VIEW



FRONT VIEW



Our approach: In many cases, especially in apple orchards, there is a 3-meter gap between the rows of trees, and the rows themselves are very narrow, creating a “fruit wall” configuration. Other crops, such as berries, grapevines, or vines in general, are also grown in narrow rows. If we could irrigate only the row itself, without applying water to the spaces between rows, we would be able to save huge amounts of water, making it possible to protect a much larger area at the same time. We would save money on the irrigation system requirements and we would prevent damage caused by applying sometimes up to 50 m<sup>3</sup>/hectare each hour for the duration of the night.

The bottom line is precision. Only the plants need to be protected; not the roads or the spaces between trees.

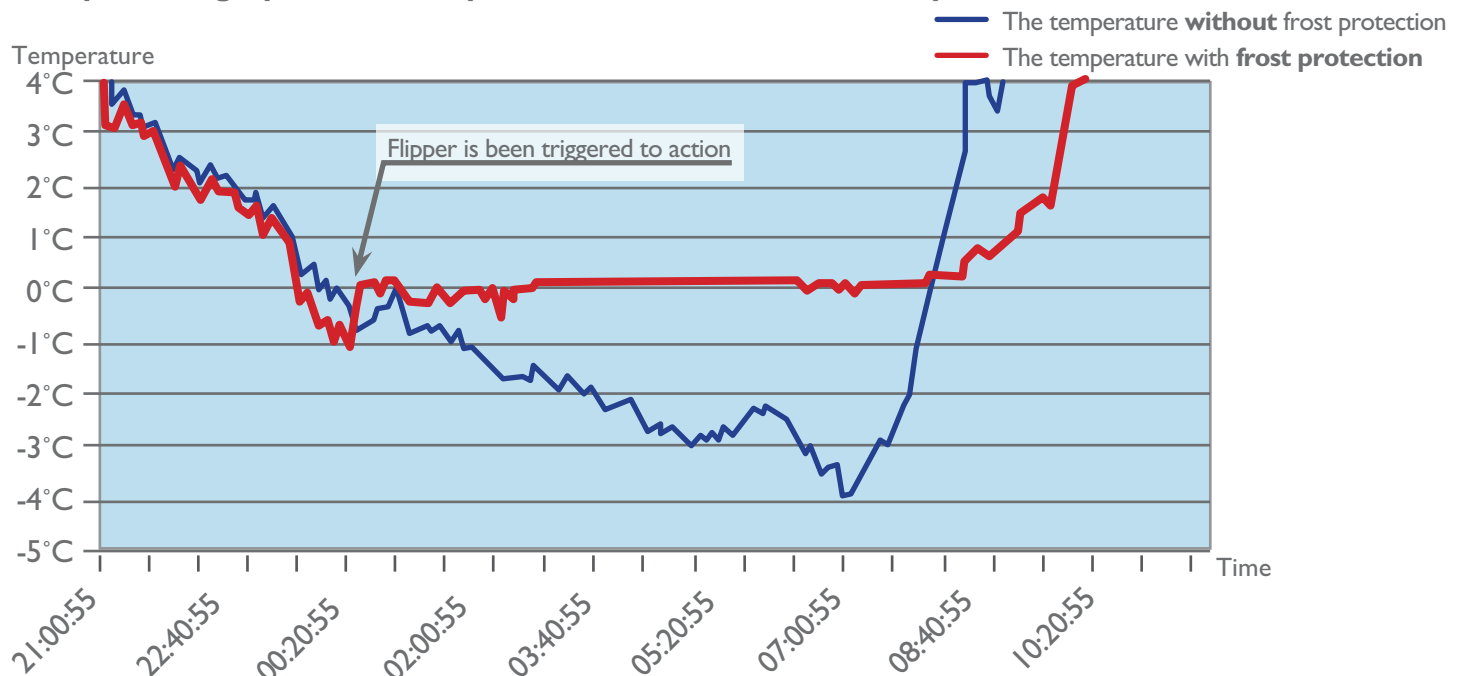
The Flipper allows us to do all that with flying colors! While applying significantly less water per hectare, we provide the same exact protection.



### Flipper

- Recommended working pressure: 2.0-3.0 bar
- Flow rate: 25-45 l/h
- Filtration requirements: 130 microns (120 mesh)

### Comparative graph of the temperature with vs. without frost protection





# SOLUTIONS FOR CROPS

## EFFECTIVE PRECIPITATION\*

System	Sprinkler	Spacing (m)	Flow rate (l/h)	Rate (mm/h)	Discharge (m <sup>3</sup> /ha/h)
Full coverage	Impact	18x18	1610	5	50
Targeted	2002	2x5	35	5	35
Strip	Flipper	7x3	35	5	16.6

\*This chart present a representative samples of the wide range of NaanDanJain's frost protection solutions.

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