Lettuce
& Green-Leaf Crops

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ABOUT LETTUCE AND GREEN-LEAF CROPS

- Lettuce is one of the most common crops, grown in many areas and in a variety of species.
- Lettuce, like other green-leaf crops, is characterized by a shallow root system that requires a strict irrigation regime and control.
- Moisture management throughout the growing season is a critical factor for the production of commercial quality lettuce and green-leaves. Even relatively short periods of inadequate soil moisture can adversely affect the crop.
- Lettuce yields can reach up to 50-70 tons/hectare, depending on the species, number of growth cycles and soil conditions.
- Duration of growth on soil: in the autumn 60-90 days, in the summer 21-30 days.

CLIMATE

The lettuce plant is best suited to a moderate climate, with temperatures of 13-16 C°.

- During germination, temperatures of 7-24 C° are required.
- Short days are ideal for growing lettuce. Days lasting longer than 12 hours cause the lettuce to bloom.

SOIL

- Neutral light soil (pH-7) or acidic soil characteristics are preferable, but commercial yields can also be achieved in heavy soil conditions.
- The lettuce is sensitive to cold and salinity. Water with an EC of 1.3 or less should be used for irrigation.

IRRIGATION OF LETTUCE AND GREEN-LEAF CROPS

The purpose of irrigation is to prevent water stress, especially during the formation of the part of the plant that will be harvested.
Water stress can occur in a crop when the soil moisture is excessive or when it's deficient. When oxygen concentration levels in the soil atmosphere are lowered due to displacement by water for an extended period of time, the root system can be severely damaged.
Lettuce and green-leaf plants are especially susceptible to water stress due to their shallow root systems.

Water stress can lead to two main problems:

- Poor yields and poor product quality (in terms of firmness, head size, and color) due to damage caused to the head lettuce.
- Rot at the base of the roots.

Moisture deficiencies occurring early in the crop cycle may delay the maturity season and reduce yields. Shortages later in the season often lower quality, as well as yields. However, irrigation surplus, especially late in the season, can reduce both the quality and the post-harvest life of the crop.
Uneven or surplus irrigation, above the amount required to replace evapotranspiration, causes nitrate leaching below the root system and the ability of the crop to recover from the nitrogen deficiency decreases.

Efficient water use, namely irrigation scheduling, high uniformity of water distribution and light precipitation rate, will help prevent stress conditions.

IRRIGATION SCHEDULING

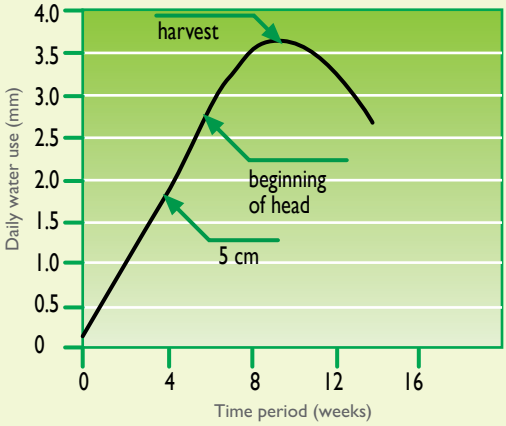
- To prevent water stress, aim at an irrigation threshold of 20-30% water deficit. With tensiometers, use 10-25 centibars to trigger irrigation, according to soil type.
- Otherwise, irrigate every 1-3 days.
- During hot weather it is preferable to pulse irrigate in order to preserve high humidity.

WATER REQUIREMENT CALCULATION:

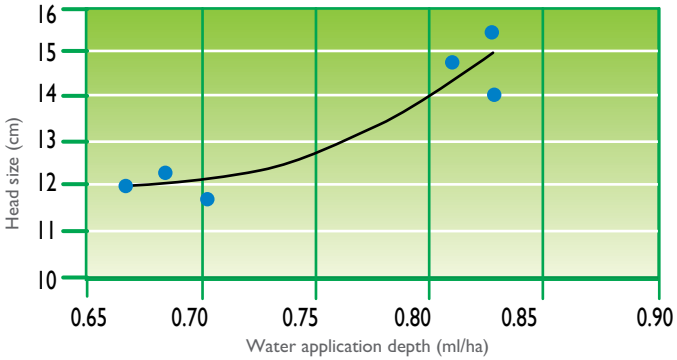
Water requirement = daily ET (Evapotranspiration) x crop factor.

Range of crop factor is 0.25-0.9.
The crop factor is related to canopy coverage:
Canopy coverage = Ca x Cb
Ca= coverage between plants (%)
Cb= coverage between rows (%)

TYPICAL CURVE OF WATER CONSUMPTION VS. GROWING STAGE



LETTUCE HEAD SIZE VS. WATER QUANTITY



IRRIGATED PERFORMANCE AND POTENTIAL AGRONOMIC GAINS THROUGH IMPROVED UNIFORMITY*

Crop	Irrigation system	Region	AE (Application Efficiency)	Measured DU	Seasonal irrigation ML/ha/yr	Potential agronomic gain if DU > 90%
Lettuce	Solid-set	Lockyer Valley	80-100%	70%	1.1	13%

* Source: Scott A. Barber, Steven R. Raine and Evan J. Howard
Queensland Fruit and Vegetable Growers Ltd. Brisbane, Australia.
National Centre for Engineering in Agriculture, USQ, Toowoomba, Australia

FERTILIZATION

Potassium and phosphorus are recommended at the start of the season. Nitrogen is recommended during the growing season. Using Nitrogen in nitrate form helps to minimize tipburn.

NAANDANJAIN IRRIGATION SYSTEMS

High investment costs are associated with producing green-leaf crops. Selecting the most suitable irrigation system and managing it efficiently is crucial for success. NaanDanJain offers a number of solutions: Irristand or drip systems are ideal for open field, while inverted micro-sprinklers are best for greenhouse irrigation.

IRRISTAND SYSTEMS

The IrriStand system for lettuce and green-leaves is a low-flow sprinkler that simulates light rain. Based on a flexible in-and-out solid-set PE system, the system successfully meets all crop requirements at all stages of development:

- Germination
- Uniform irrigation (while maintaining soil aeration conditions)
- Continuous application of nitrogen
- Micro-climate
- Prevention of soil erosion
- Frost protection

IrriStand laying operation

Main system advantages

- Low precipitation rate
- High efficiency and uniform water distribution
- Full control over wetted profile
- Availability of optimal moisture and nutrients for the root system
- Increase of lettuce production up to 70 tons/ha, according to species and season

High distribution uniformity and low application rate, at frequent irrigation cycles, provide maximum control and monitoring of the wetted and aerated soil profile, which is essential for the shallow root system of the lettuce.

Low application rate (3-5 mm/h): allows optimal absorption of water into the soil with no run-off, even on slopes.

Low droplet impact: preserves soil structure and prevents crust formation to allow perfect germination and development.

Short irrigation cycles: prevents stress caused by water surplus; provides optimal growing conditions with highly accessible moisture and nutrients in a controlled wetted and aerated soil profile; and ensure no nitrate leaches below the root zone and leakage into the groundwater.

AMIRIT SYSTEMS

Based on the IrriStand concept, Amirit is a solid-set system including 50 mm PE pipes with 10-12 meter segments. The system is flexible, portable and easy to operate.

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SPRINKLERS FOR IRRISTAND AND AMIRIT SYSTEMS

NaanDanJain has developed a wide range of sprinklers for the irrigation of lettuce and green-leaf crops. Characterized by their sturdy construction, corrosion resistance and extremely high water distribution uniformity, they respond to the specific field conditions.

SERIES OF 1/2" SPRINKLERS WITH LOW PRECIPITATION RATE

Characterized by excellent water distribution uniformity and reliability at low pressure conditions.

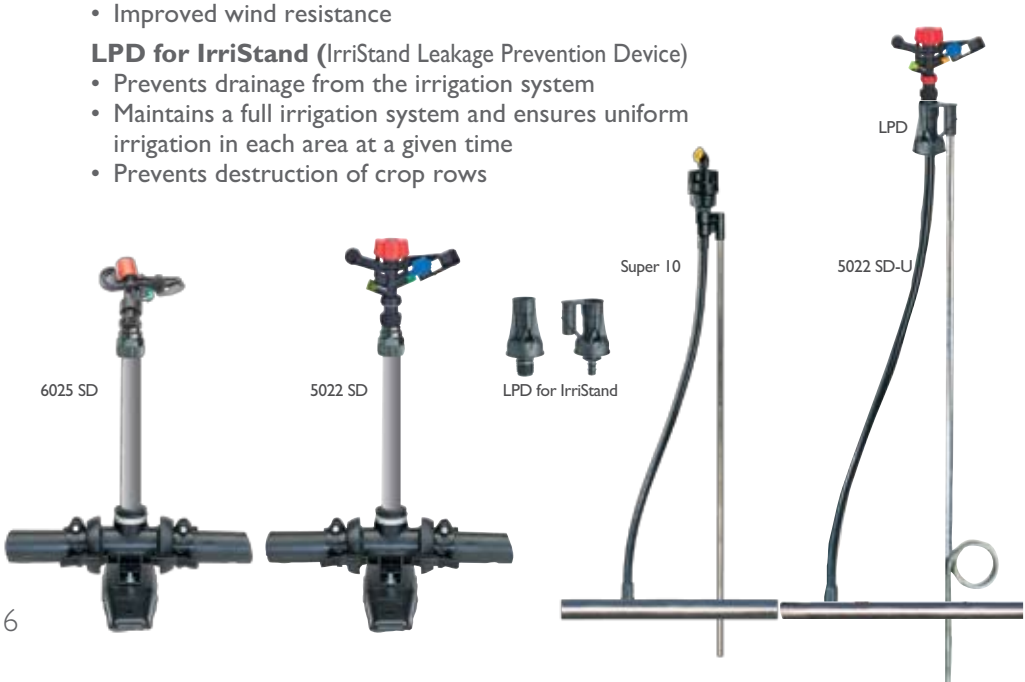
Super 10
- Compact ball-driven sealed mechanism for spacing up to 12 m
  Available with flow regulator

5022 SD-U
- Low flow single or double nozzle for spacing up to 12 m

5022 SD
- Single larger nozzle concept with unique SD hammer for spacing up to 14 m

6025 SD
- Single larger nozzle concept with unique SD hammer for spacing up to 16 m
- Improved wind resistance

LPD for IrriStand (IrriStand Leakage Prevention Device)
- Prevents drainage from the irrigation system
- Maintains a full irrigation system and ensures uniform irrigation in each area at a given time
- Prevents destruction of crop rows



DRIP SYSTEM

NaanDanJain has developed a special drip concept to meet the needs of lettuce and green-leaf crops. The wetted uniform strip is based on low flow rate drippers, close dripper spacing and excellent uniformity. The drip irrigation concept combines accurate water and fertilizer applications.

The Wetted Strip

The concept of a continuous wetted strip creates optimal growing conditions for densely cultivated crops with shallow roots, such as lettuce.
This prevents the deep percolation of water and nutrients under the shallow root system into the ground water, which can create pollution.

Product Selection and Design

Based on the particular agro-technical needs of lettuce crops, two main products are highly recommended.

TalDrip Dripline

- Light dripline with molded and integrated Cascade drippers.
- Effective, uniform crop irrigation with low CV and high EU% standard.
- Clog resistance: self-cleaning design with a double-flow
- regime that continuously flushes out small dirt particles.
- Available at 16-23 mm diameter, 6-35 mil wall thickness
- Dripper flow rate: 0.6, 1.0, 1.7 l/h
- Dripper spacing: from 15 cm

TalDrip

Chapin

- Economical thin-walled drip tape
- Turbulent flow twin wall
- Clog resistance: unique turbulent flow path with wide cross-section
- High resistance to insect damage and field abrasion.
- Available at 16, 22 mm diameter, 6-15 mil wall thickness
- Slit outlets reduce root intrusion

Chapin

Basic Design Recommendations

Drip lateral spacing: one lateral for two closed rows
Dripper spacing: 15-30 cm, depending on soil type
Dripper flow rate:
Tal Drip: 0.6, 1.0 l/h
Chapin BTF: 4.8 l/h per meter (0.96 l/h per outlet)

DOUBLE SYSTEM CONCEPT

Based on farmers' needs and specific field conditions, NaanDanJain has developed the double system solution: sprinklers (portable Irristand system) and drip, for maximum potential.

Stage 1: Soil preparation and bed cultivation, using over-head Irristand system
Stage 2: Pre-season application of chemicals, using Irristand
Stage 3: Germination or seedling establishment, using Irristand
Stage 4: Irrigation and fertigation throughout the season, using the drip system
Stage 5: Technical irrigation, such as cooling and dust washing, using Irristand

The Irristand system can be shifted from plot to plot, for germination purposes only.

SOLUTIONS FOR GREENHOUSE LETTUCE CROPS

Greenhouses, tunnels or net houses improve the growing conditions of lettuce and green-leaf crops.
NaanDanJain has a targeted solution for these conditions:
A range of inverted micro-sprinklers, installed under the greenhouse roof.
A wide range of flow rates to match the specific precipitation rate required, according to the optimal irrigation time.
User-friendly software (the "Space"), especially adapted to greenhouse and tunnel conditions to achieve maximal uniformity (CU 88-95%) of design.

Lettuce with Inverted Modular 4x4 m

Recommended Inverted Micro-Sprinklers
The common guideline for all models is: height of installation is 120-200 cm above crop level, or as per the local conditions. All models are compatible with LPD (Leakage Prevention Device).

Green Spin
- Bridgeless: no dripping during operation
- Excellent uniformity
- Flow rate: 43-200 l/h
- Spacing: up to 4.0 m
- Anti-mist combination available

2005
- Inverted anti-insect micro-sprinkler for extra range application
- Uniform coverage over a wide range of spacings, flow rates and pressures
- Large droplets
- Flow rate: 35-200 l/h
- Spacing: up to 6.0 m

Modular
- The traditional inverted model
- Flow rate: 35-300 l/h
- Spacing: 3-5.0 m
- Anti-mist combination available

THE SINGLE LINE AND ANTI-MIST CONCEPT

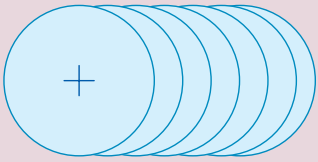
NaanDanJain has developed a specific solution for tunnel conditions, taking into consideration the tunnel shape and the required needs, in order to achieve optimal effective irrigation.
The single line creates a uniform strip with relatively big droplets and higher precipitation rate. It is suitable for tunnels up to 6.0 m in wide. Wider tunnels require 2-3 lines.

Modular with anti-mist on LPD

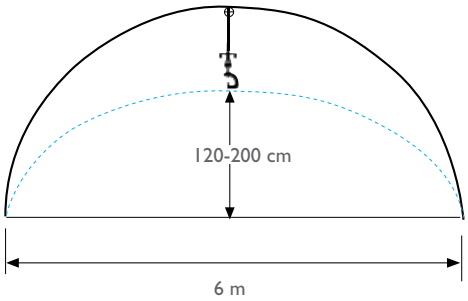
GreenSpin with anti-mist

THE BENEFITS

The side by side layout, using the anti-mist device, achieves maximum uniformity at specific wetted strip.



Inverted rotor for tunnels, up to 6.0 m wide



High precipitation rates
Allows irrigation over a shorter time scale and causes reduced humidity, resulting in plants staying dry longer.

Dry walls
NaanDanJain's unique combination of nozzle and anti-mist provides an ideal solution to this traditional greenhouse irrigation problem.

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NaanDanJain is committed to finding the ideal solution for your lettuce and green-leaf crop, tailored to your local climatic conditions, soil and water properties and budget. Contact our office or your local dealer for further information.

All information should be used only as a guideline. For specific recommendations contact your local agronomist.

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