Nutrigation™ - Benefits and Practice

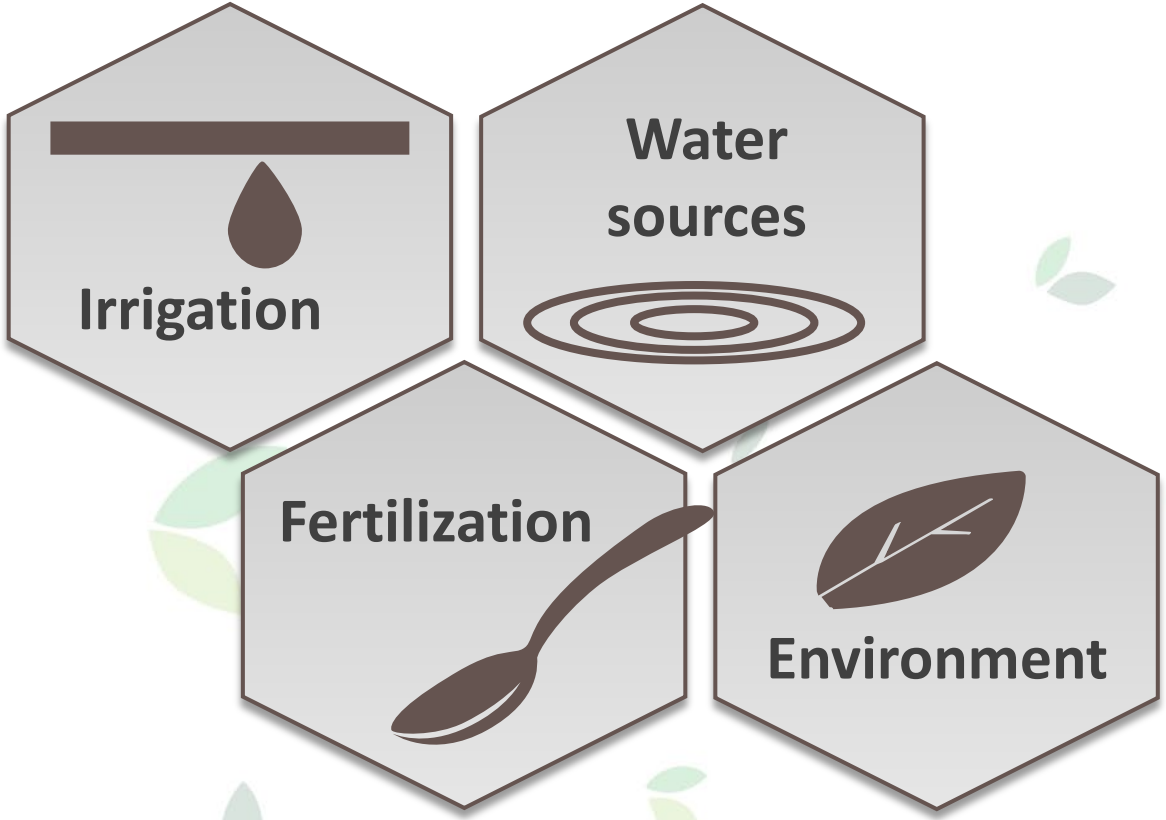
Tal Shani

Soluble Fertilizers Marketing Manager

Contents

Water and nutrient use efficiency

Water saving opportunities



Irrigation

Furrow

Jet

Pivot

Sprinkler

Drip

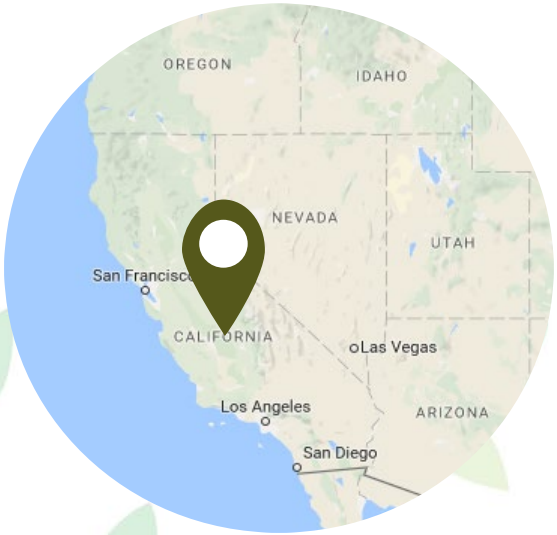
Drip irrigation **saves water**

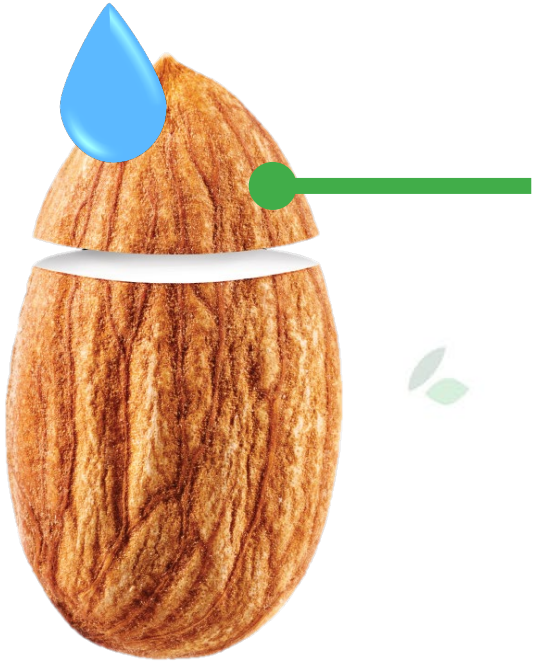
-52%

+17%

Norton, E.R. & Silvertooth, J.C.
The University of Arizona, College of Agriculture and Life Sciences, 2001
From Netafim website http://www.netafim.com/article/cotton-article-2?55146

Drip irrigation **increases yields**

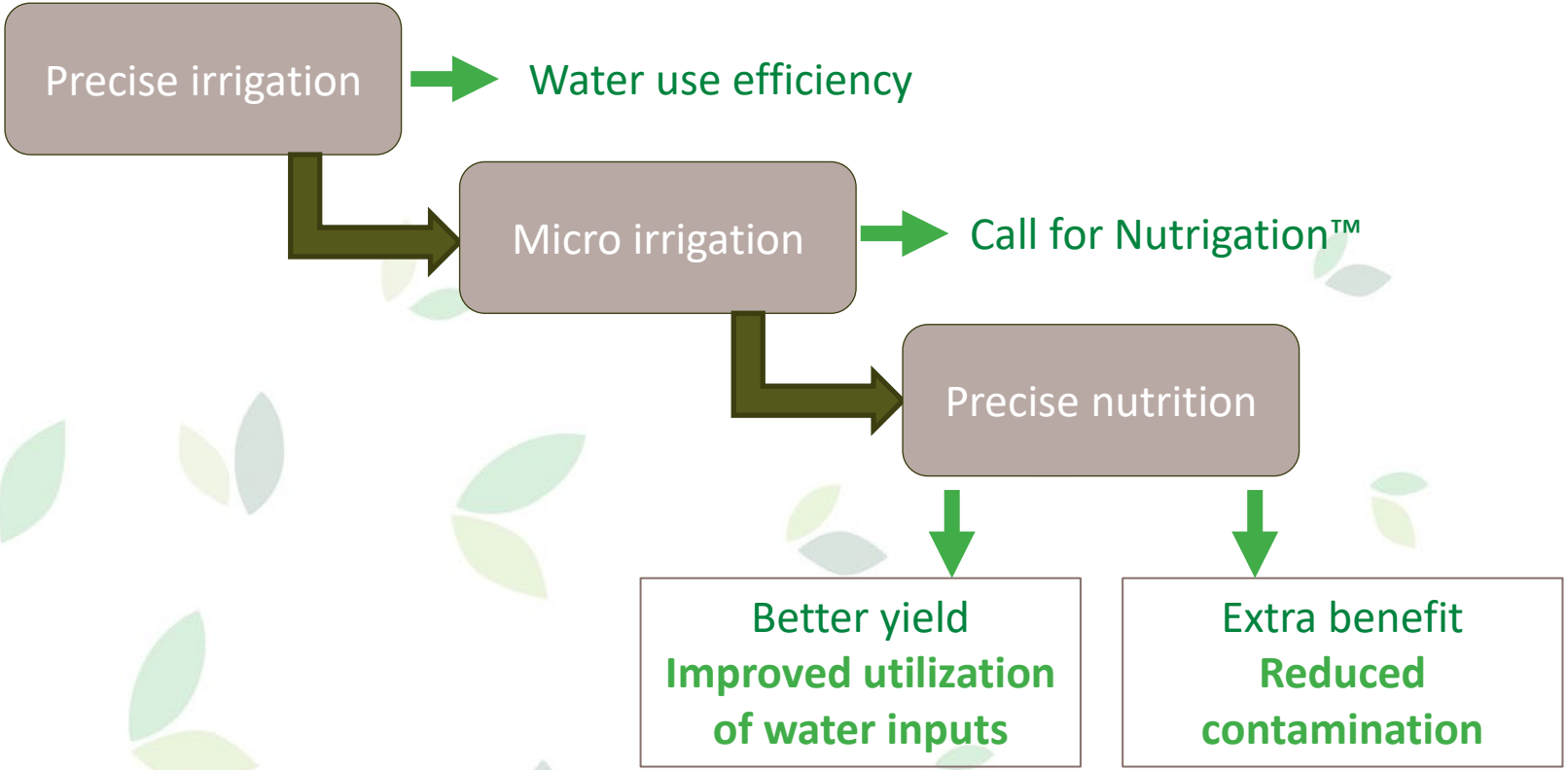




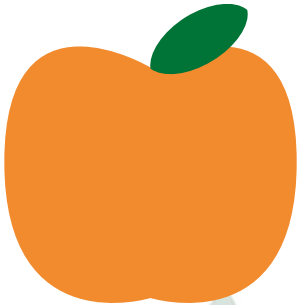
+ 60%

From each drop

Nutrigation™ completes precise irrigation



Higher Nutrient Use Efficiency (NUE)



- Higher yield
- Better quality
- Enhanced stress tolerance

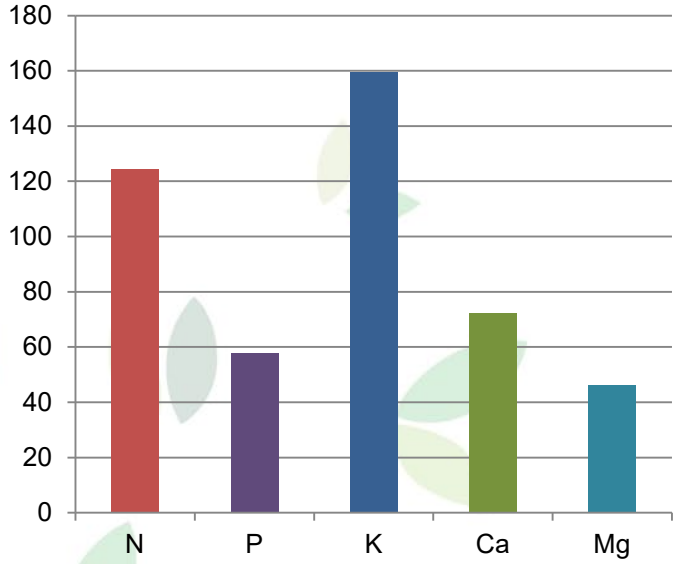
- Reduced pollution
- Minimized contamination of groundwater
- Better use of land and water

About Nutrigation™

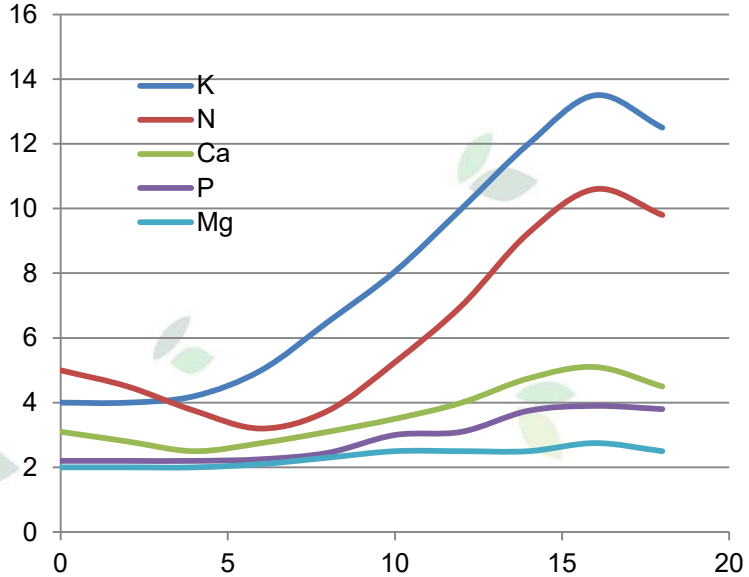

Nutrigation =
Nutrition + Irrigation
Water and plant nutrients are delivered simultaneously
through the irrigation system,
in precise combination and timing.

Dynamics of Nutrient Uptake

Annual uptake….



… is not consumed at once



The charts show nutritional requirements of tomatoes (grams per plant)
Left: total for the season. Right: weekly consumption.

Nutrigation™ follows uptake dynamics

Nutrigation™ enables optimal match between plant requirements and nutrients supply:

Precise timing

Precise composition

Precise place

Precise rate

The benefits of Nutrigation™

Benefits for the crop

- **Optimal crop development** due to precise supply of plant's growth needs
- **Continuous plant nutrition** with no temporary deficiencies
- **Precise placing** - nutrients are directed to the active root zone
- **Readily available** - nutrients are already dissolved, hence ready for uptake by the roots
- **Uniform distribution** of nutrients

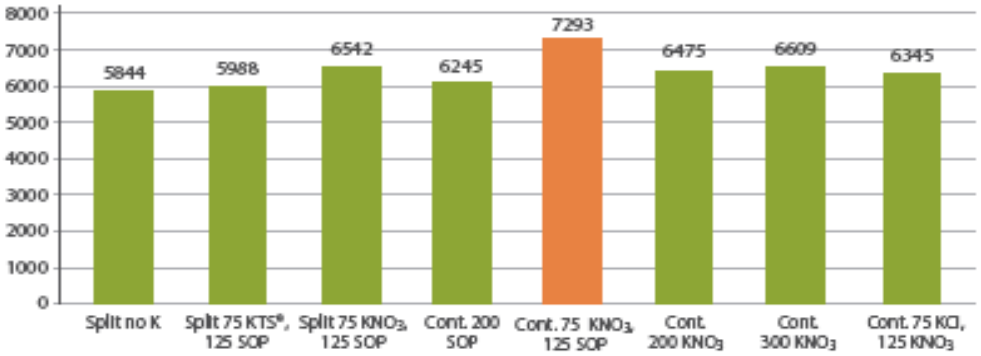
Benefits for the system

- **Reduced losses** of nutrients by leaching.
- **Saving on application** by machine / manual spreading.
- **Flexible application** (time, weather, soil).
- **Minimized contamination** of soil and groundwater
- **Less soil compaction**, hence better root performance
- **Reduced weed population**, hence less herbicide costs

Proven Benefits: Nutrigation™ for almonds

In a long term fan jet almond fertigation trial, treatments that included 100% potassium nitrate (KNO_3) as a proportion of the K fertilizer, resulted in higher yields than treatments containing SOP or K-T* either alone or in combination.

Up to 20% more yield



Research by Patrick Brown et al. University of California, Davis 2012-2014.
Split = 4 episodic applications | Cont. = continuous, 22 applications

Nutrigation program that included potassium nitrate resulted in up to 20% more yield compared with programs that involve other sources of potassium.

Research by Patrick Brown et al. University of California, Davis 2012-2014.

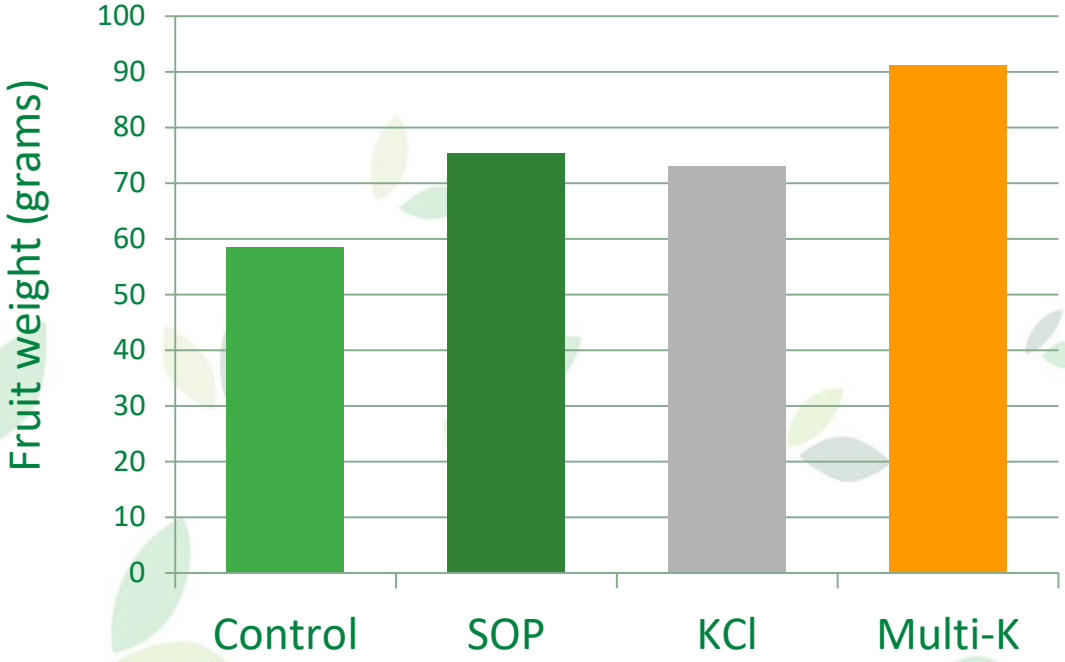
Proven Benefits: Nutrigation™ in citrus

Treatments

- Control (without potassium)
- Potassium sulfate liquid fertilizer
- Potassium chloride liquid fertilizer
- **Haifa Multi-K™**

The trial was performed in 2015 at the Institute Valenciano of Agricultural Research (IVIA), Spain

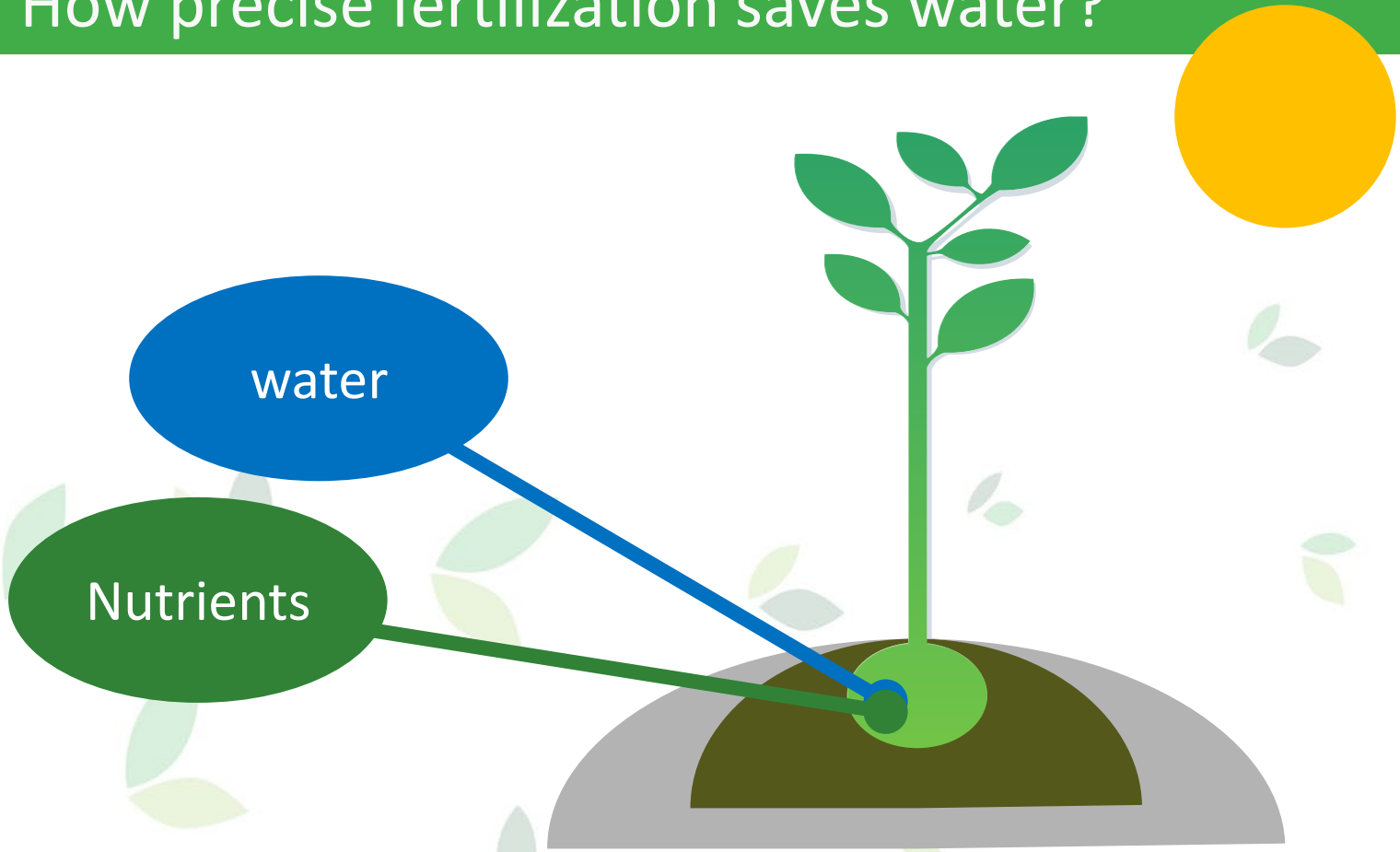
Proven Benefits: Nutrigation™ in citrus



Multi-K™ treatment:

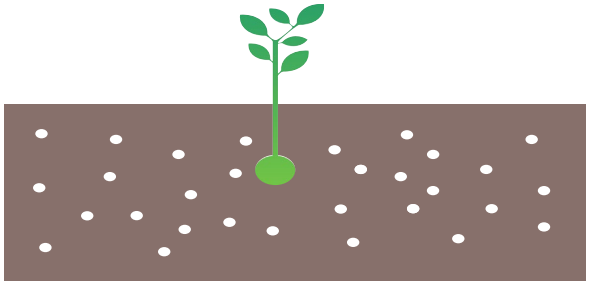
- **Higher yield**
- **Larger fruits**

How precise fertilization saves water?

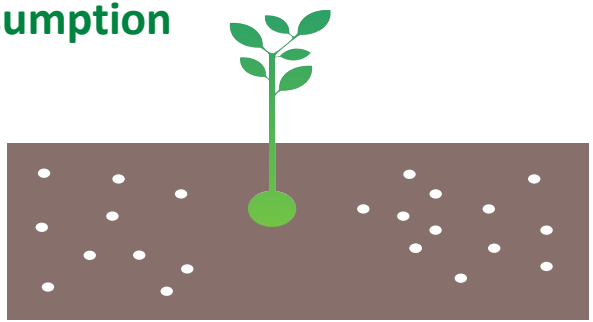


Salinity build-up: how it happens

Application

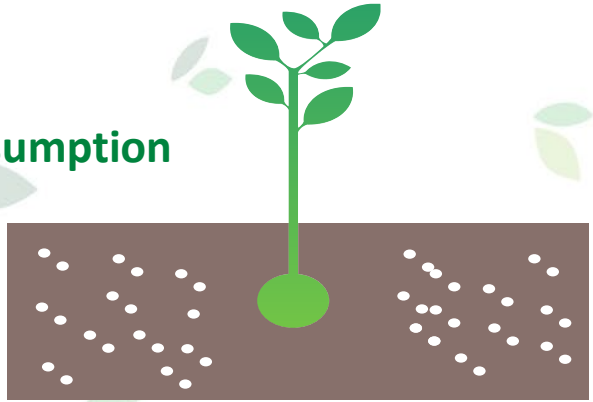


Consumption

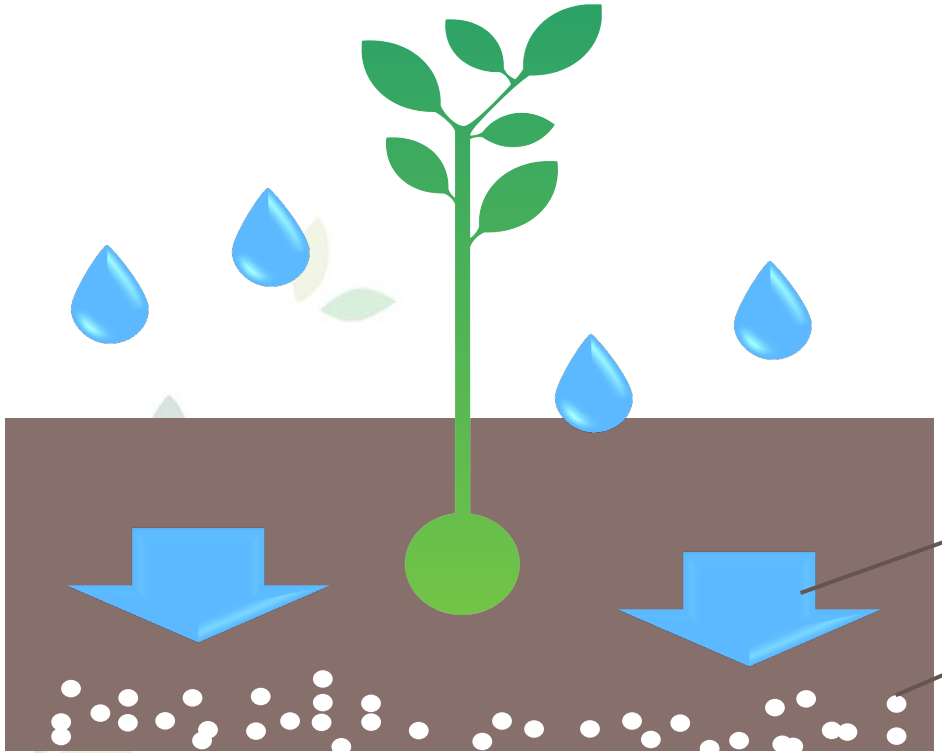


Application

Consumption



Salinity build-up: how to correct it

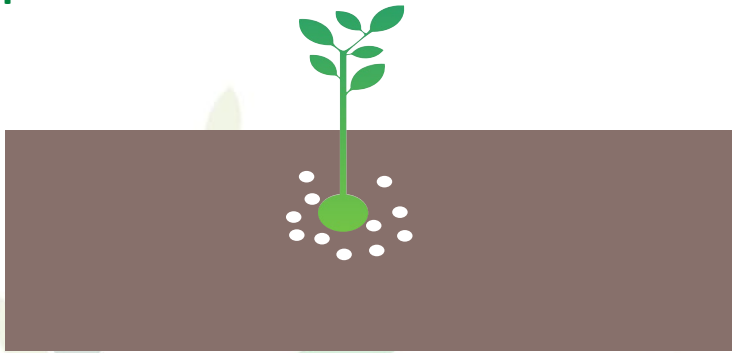


Waste of water

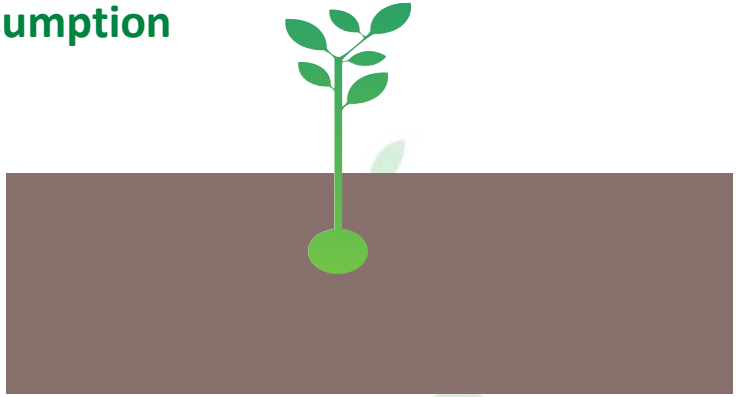
Contamination

Salinity build-up: how to avoid it

Application



Consumption



✓**Nutrigation**

Nutrigation™ practices

Basic guidelines

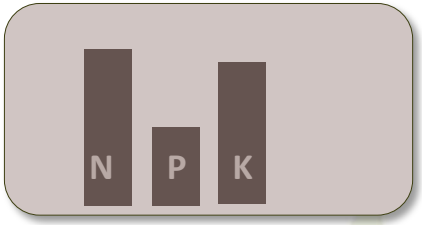
Nutrients availability should follow plant's requirements

No nutrient can replace another one

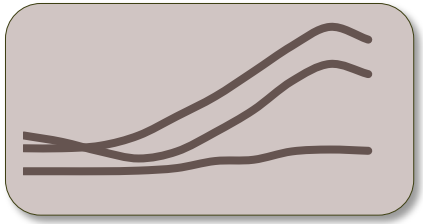
Nutrient uptake rates are crop-specific

Nutrients should be available to the plants "Just- on-time"

Setting a Nutrigation™ program

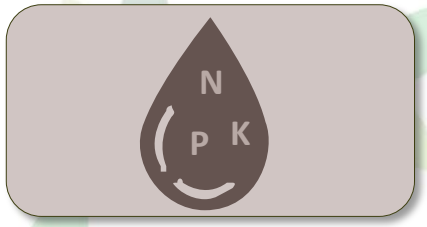


Crop's nutritional requirements

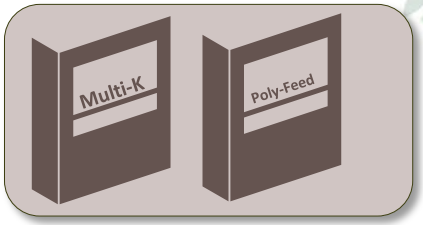


Nutrients requirements by growth stage

Irrigation plan



Nutrient rates in the irrigation



Select fertilizers

Water Management

Plant water requirements

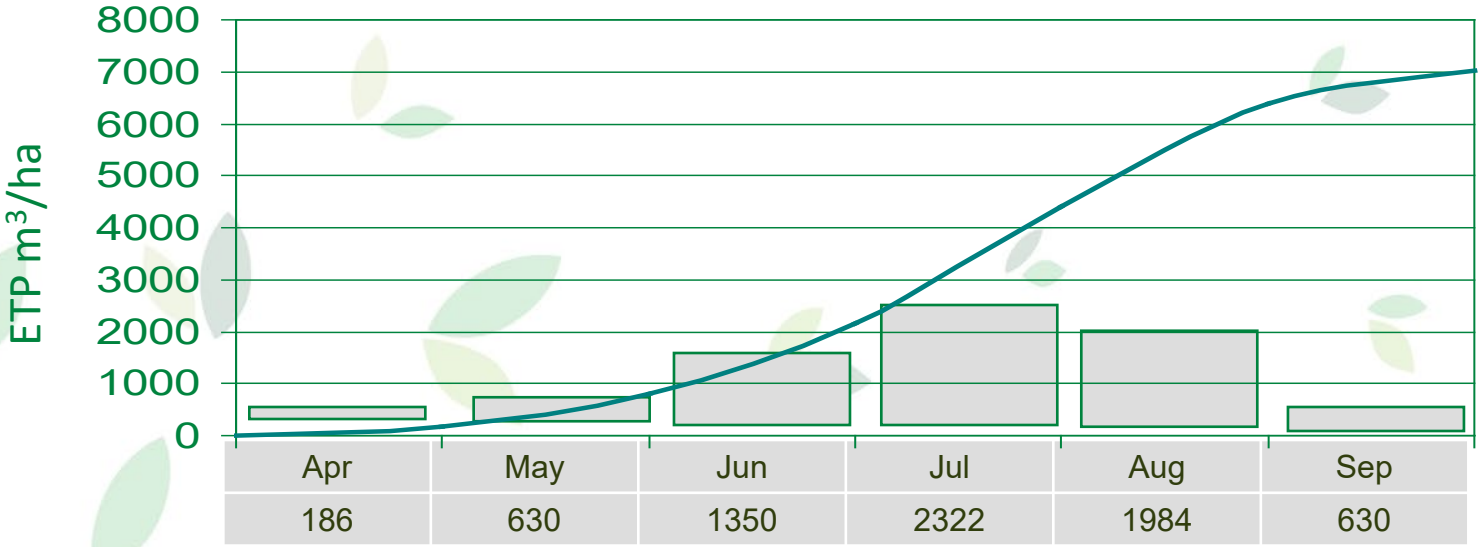
Irrigation equipment

Soil type

Plant water requirements

Example: monthly and cumulative ETP of cotton

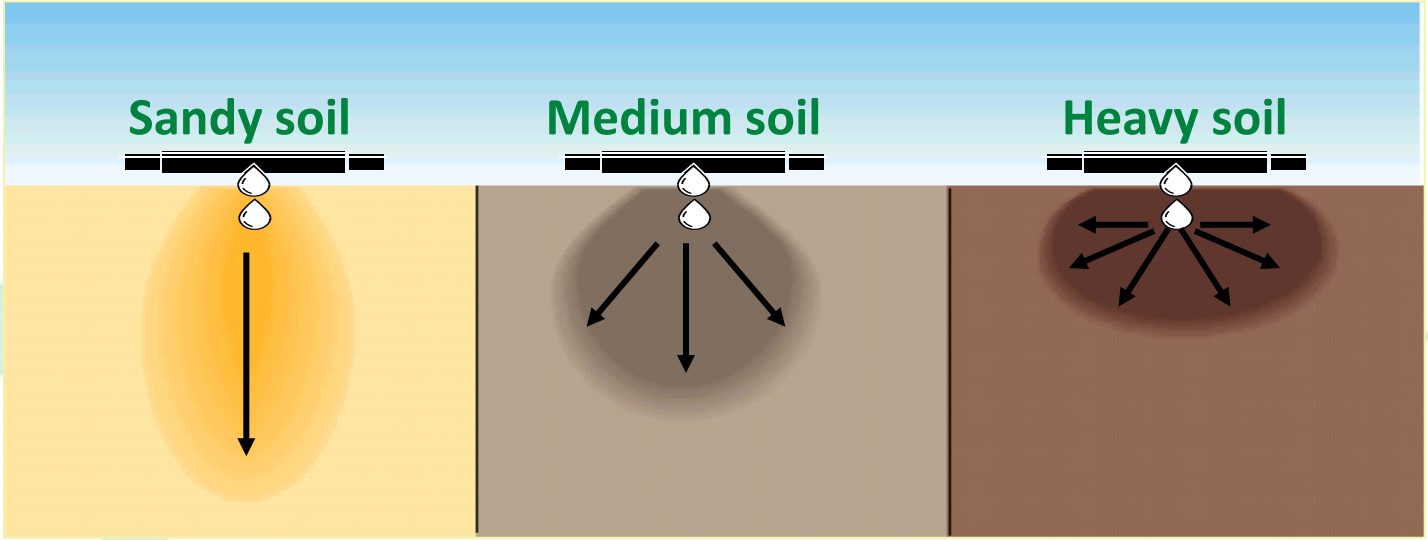
Cumulative ETP = total amount of water required



Apr	May	Jun	Jul	Aug	Sep
186	630	1350	2322	1984	630

Soil type

Soil type affects the direction and speed of water movement, therefore should be regarded when setting irrigation rates.



Fast infiltration →
Small water portions at short intervals

Slow infiltration →
Larger water portions at longer intervals

Irrigation equipment

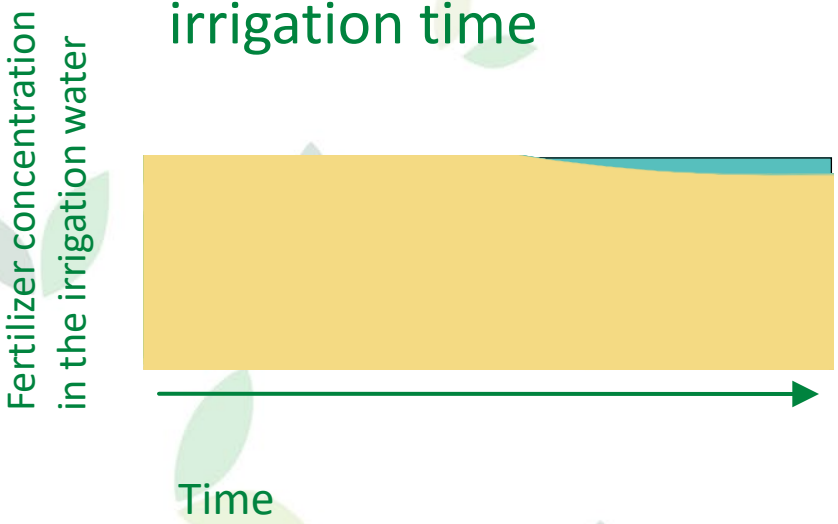
Choice of irrigation equipment depends on

- Cost consideration
- Soil type → infiltration rate and pattern
- Topography
- Available water pressure
- Density of planting and root system

Nutrigation Methods

Quantitative

Fertilizer is applied in **one pulse** during a part of the irrigation time



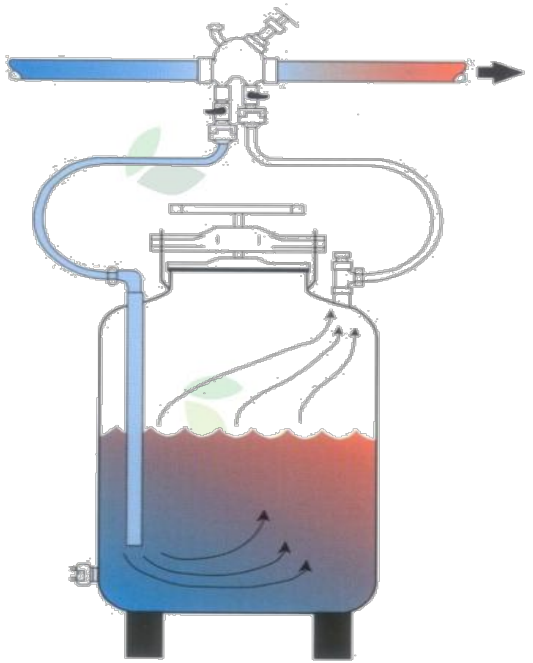
Proportional

Fertilizer concentration in the irrigation water is kept **constant**

Quantitative Nutrigation

Used in orchards and in heavy soils

- The grower sets the **total amount of fertilizer**
- The fertilizer is **applied in one pulse** during the irrigation time
- **Concentration decreases with time**
- When the fertilizer is fully dissolved, 4 times of fertilizer tank volume should be passed to fully deliver all nutrients.



Example of quantitative Nutrigation™ program

Tomatoes in tunnels, 18,00 plants/ha, soil: sandy loam
Nutrigation™ with Poly-Feed

Growth phase	Number of weeks	Formula*	kg/week / ha	Total kg/ha for the period	kg/ha N	kg/ha P_2O_5	kg/ha K_2O	Water m^3/ha
Planting to flowering	5	20-20-20+ME	50	250	50	50	50	560
Flowering to Fruit set	3	14-7-21 +2MgO+ME	150	450	63	31	94	252
Fruit set to 1st Harvest	4	14-7-28 +2MgO+ME	180	720	100	50	201	672
1st Harvest to Last Harvest	12	14-7-28 +2MgO+ME	150	1800	252	126	504	3024
Total for season				3220	465	257	849	4508

Consider growth stage

Composition suits growth needs

Quantity at each stage satisfies plant's requirements

Proportional Nutrigation™

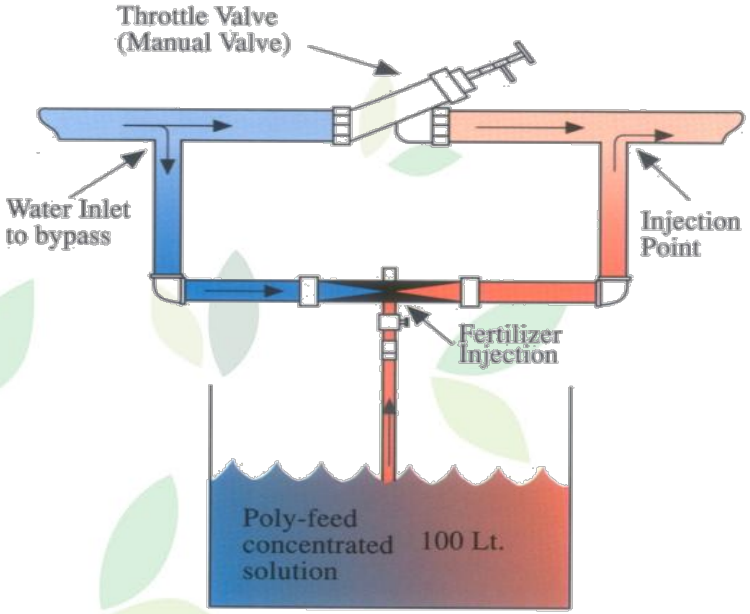
Used in light and sandy soils

- The fertilizer/nutrients concentration in the irrigation water is kept constant

- Equipment:
  - Venturi
  - Fertilizer pumps (water or electricity propelled)

Proportional Nutrigation™

Venturi (bypass)



Powered fertilizer pump

electrical or hydraulic

Proportional Nutrigation™

	Venturi	Powered pump
Cost	Inexpensive	High
Maintenance	Simple	Complicated
Control over concentration	By size of orifice	Fine, may be automated
Discharge rate	Low	Flexible
Loss of pressure	Might be high	Negligible

Proportional Nutrigation™

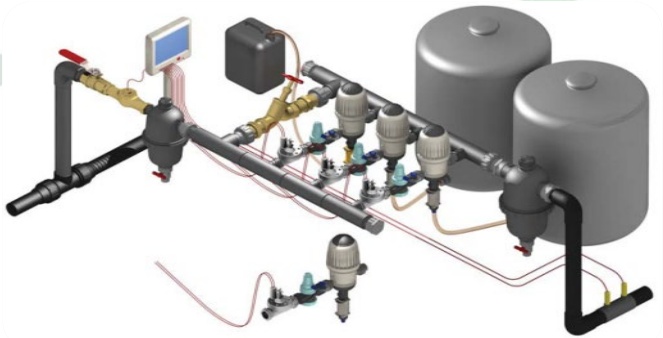
Simple Proportional Nutrigation™ methods:

- Proportional injection pumps
- Fix ratio between tanks A+B+C
- No EC and pH control or monitoring

Proportional Nutrigation™

Sophisticated Proportional Nutrigation™ and irrigation control unit

- Fertigation according to EC and pH level
- Online injection, monitoring and adjustment
- Data collection and monitoring



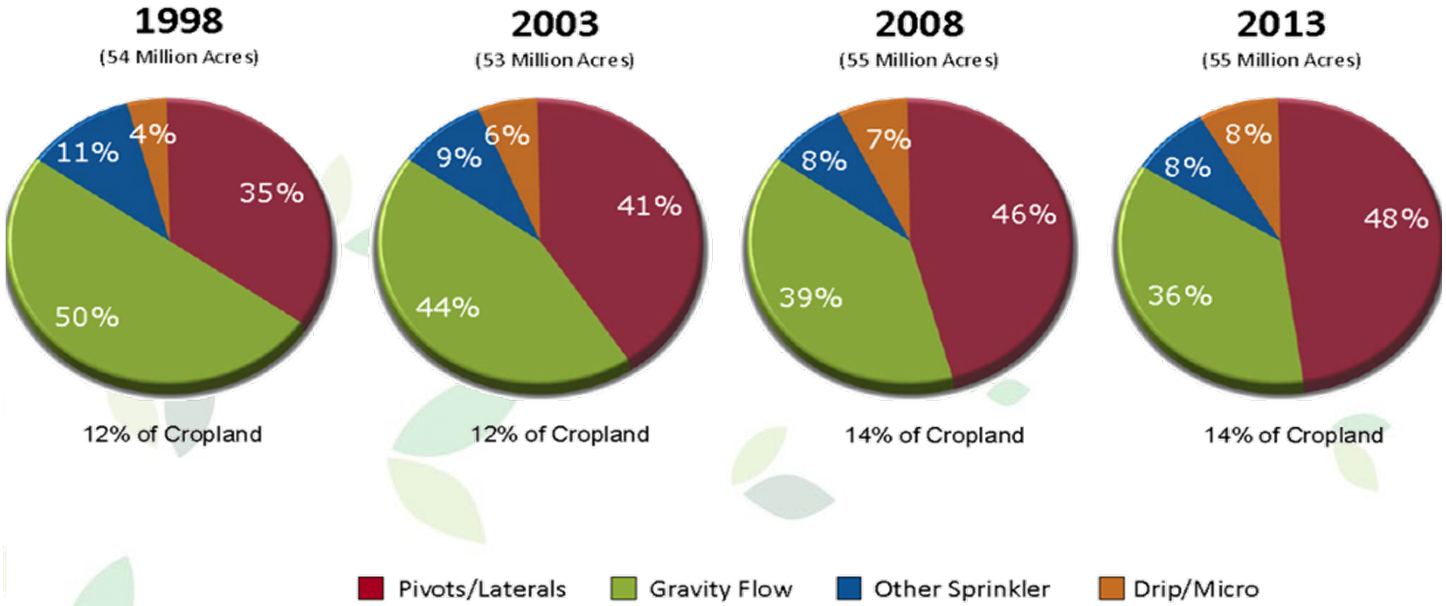
Proportional Nutrigation™ of open Field Tomato

Week	Formula*	Conc. Kg/m³	Water m³/ha/day	Water m³/ha/week	kg/ha/week	kg/ha/week			ppm N
						N	P_2O_5	K_2O	
1	20-20-20 +ME	0.3	8.0	56.0	17.0	3	3	3	60
2		0.4	13.5	94.5	38.0	8	8	8	80
3		0.5	16.0	11.0	55.0	11	11	11	100
4		0.6	18.0	126.0	76.0	15	15	15	120
5	20-9-20 +ME	0.7	23.0	158.0	110.0	22	10	22	140
6		0.7	25.0	175.0	123.0	25	11	25	140
7		0.7	28.0	193.0	135.0	27	12	27	140
8	17-10-27 +ME	0.7	36.0	252.0					
9		0.7	48.0	336.0					
10		0.7	52.0	3					
11		0.7	56.0	392.					
12		0.7	60.0	420.0					
13		0.7	64.0	448.0	314.0	53			119
14		0.7	64.0	448.0	314.0	53	31	85	119
15		0.7	56.0	392.0	274.0	47	27	74	119
16		0.7	40.0	280.0	196.0	33	20	53	119
17		0	16.0	112.0	0	0	0	0	0
Total				**4360**	**2890**	**510**	**300**	**740**	

Daily rate and composition of nutrients perfectly matches the plant's growth needs

Overhead Nutrigation™

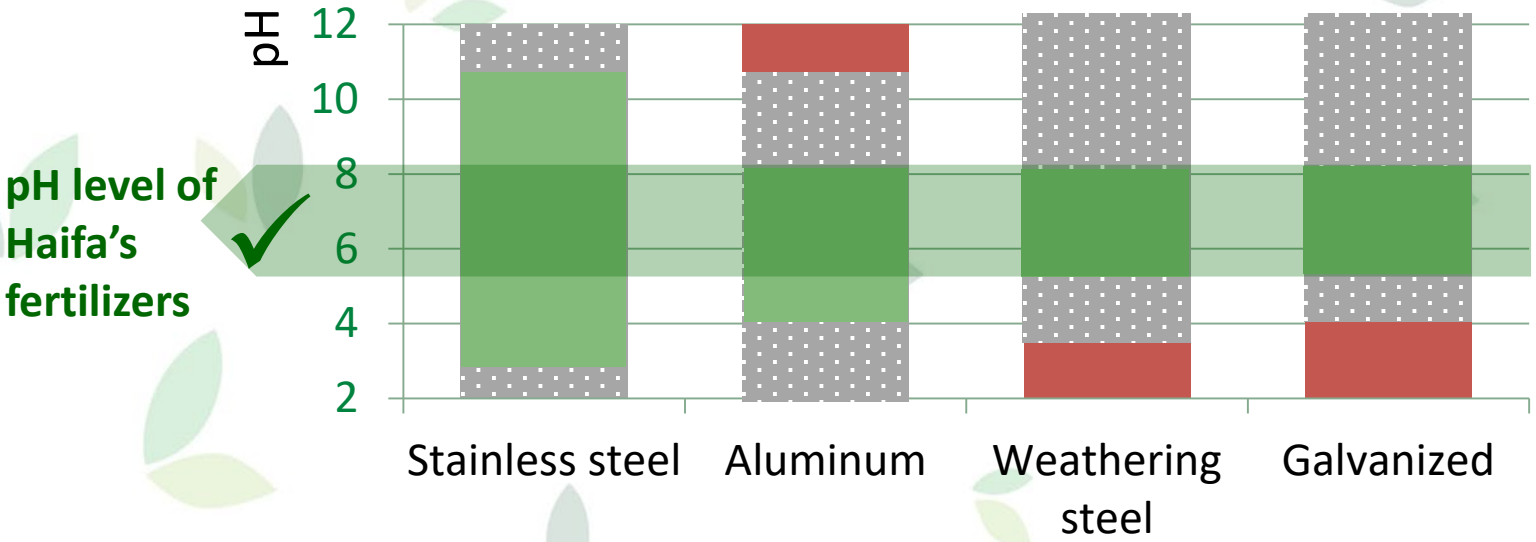
USA: Summary of macro-Irrigation areas and crops



1998, 2003, 2008 & 2013 Farm and Ranch Irrigation Surveys
USDA, National Agricultural Statistics Service
USDA published Farm and Ranch Irrigation Survey

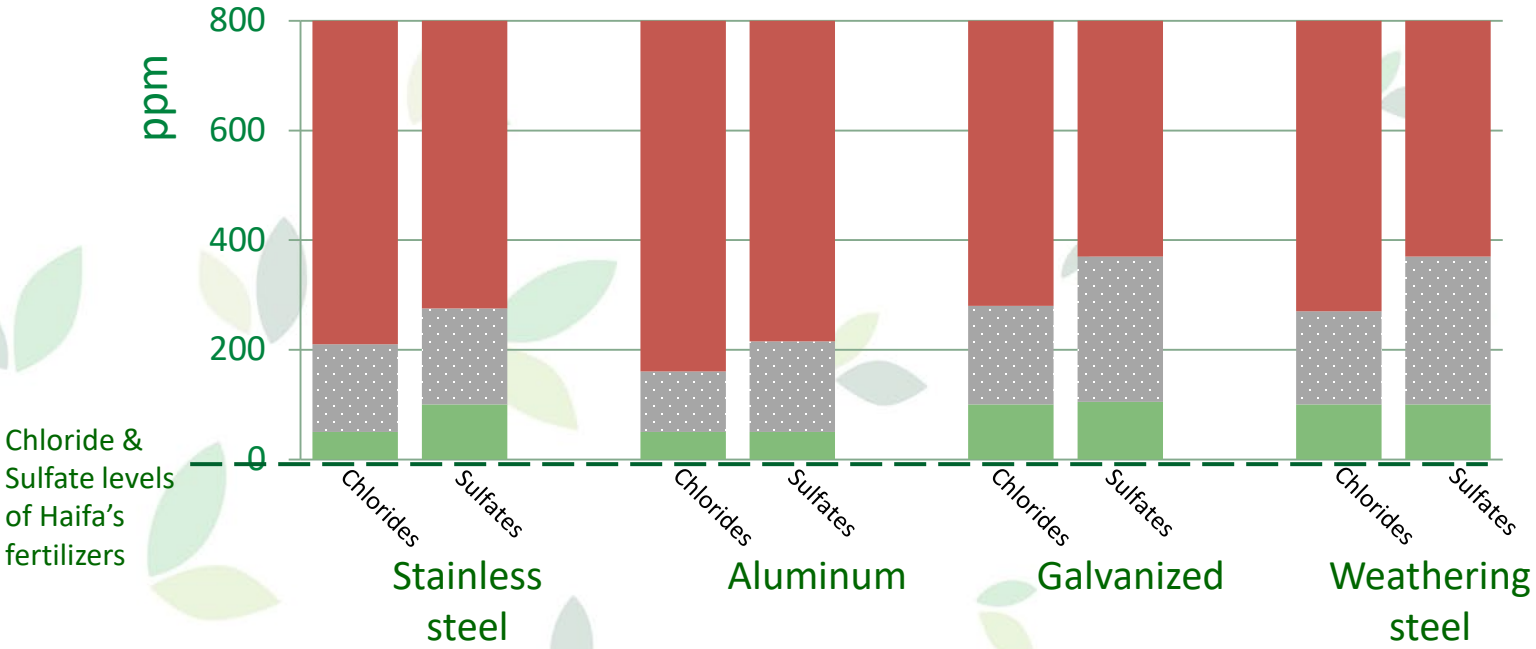
Keeping the pipes safe

- Corrosion damages to the pipes are influenced by the nutritional solution's pH
- Haifa's nutritional solutions for center pivot irrigation **keep the pH within the safe range**



Keeping the pipes **corrosion free**

- Chlorides and sulfates in the nutritional solution accelerate corrosion
- Haifa's soluble fertilizers are **virtually free of chlorides and sulfates**



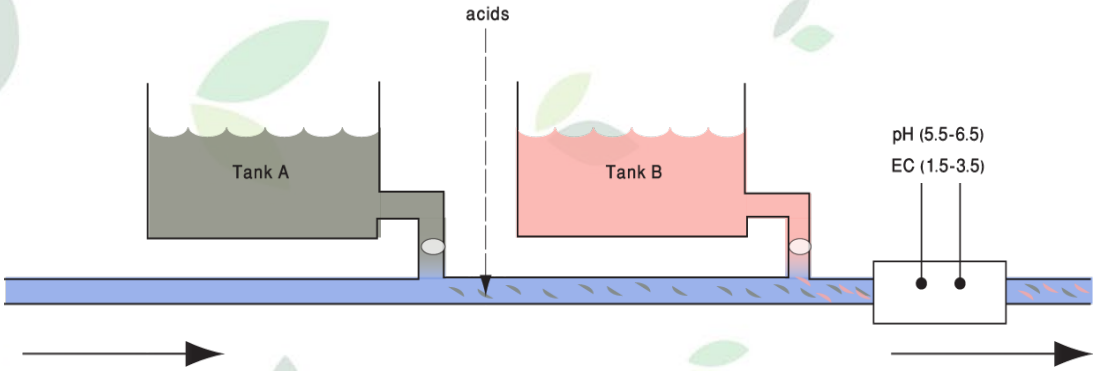
Soilless Nutrigation™

Soilless systems

- Restricted volume - **frequent irrigation**
- Inert medium - **fertilization whenever irrigating**
- Limited root mass –
  high sensitivity to shortage in water and nutrient
- **Requires careful control**

Nutrigation in soilless media

- Nutritional composition must be accurate
- EC and pH must be monitored and adjusted to ensure proper growth conditions
- **Fertilizers must be of top quality and highest purity**
- Two-Tank method is employed to prevent formation of precipitates



Two-tank system

Why the pH should be monitored

- **Changes in availability of nutrients**
  - pH>7 – Phosphorus and micro elements are fixed
  - pH<7 – Increase in micro elements solubility.
  - High acidity – Ca/Mg deficiency, Mn^{2+}, Fe^{2+}, Al^{3+}
- **Changes in ionic form**
  - For example: $H_2PO_4^-$ and HPO_4^{2-}

Crop salinity sensitivity

Threshold and yield decrease (Maas and Hoffman, 1993).

Crop	Salinity threshold (ds/m)	% of yield decrease per each ds/m, above threshold
Lettuce	1.3	13
Pepper	1.5	14
Cucumber	2.5	13
Tomato	2.5	9.9

Water soluble chloride-free fertilizers applied by Nutrigation™ minimize salinity damage

Haifa’s Nutrigation™ solutions

Haifa: Pioneering the Nutrigation™ Way

Whole range of water-soluble fertilizers

Pure plant nutrients

Free of sodium and chloride

Fully soluble in water

Certified quality

The Multi-K™ line

Classic
All-purpose

GG
Greenhouse Grade

pHast
Low pH

Reci
Near 0% sodium
For soilless greenhouses

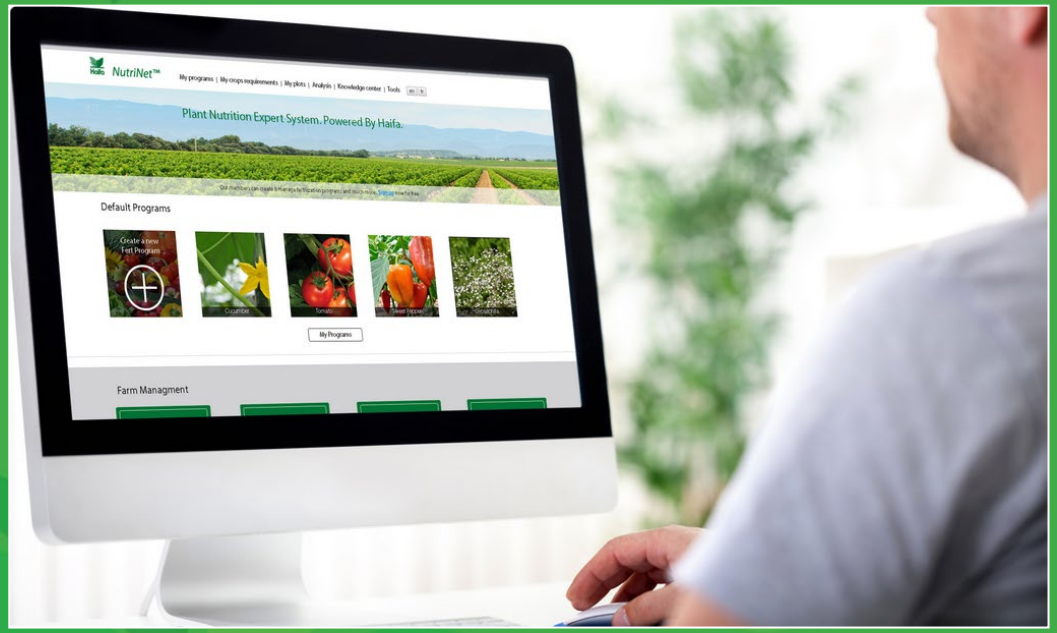
Multi-K™ enriched products

Haifa’s full range of plant nutrients

Haifa’s full range of plant nutrients

- Haifa Micro™ products are the ideal complement for plant nutrition in a broad variety of crops, for optimal development and best yield.
- Haifa Micro™ products dissolves fully and rapidly in water.

Special products for Soilless crops



Haifa NutriNet™

Haifa NutriNet™

- Plant nutrition expert system
- **Generating step-by-step Nutrigation™ program**
- Reach and updated database about crops and the Haifa solutions
- Incorporating local meteorological data, soil analysis, irrigation water quality, and more
- The service is Free of Charge

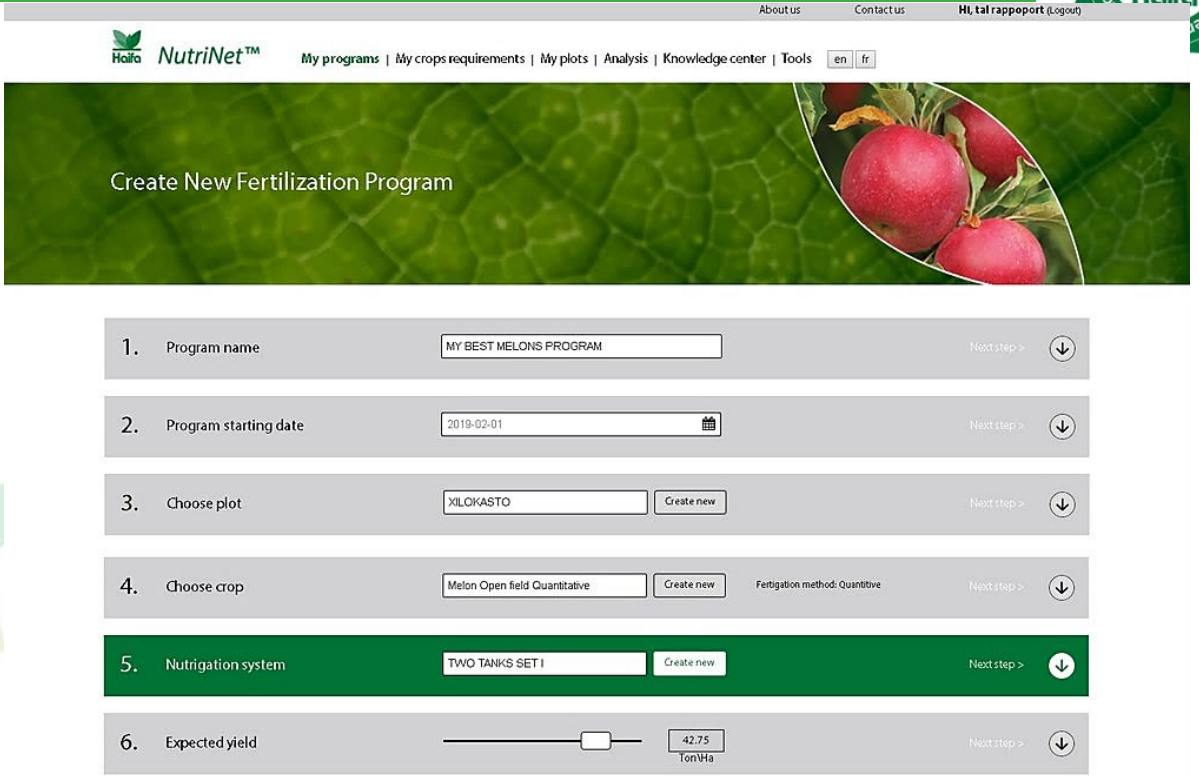
nutrinet.haifa-group.com

8 steps and you're an expert

- Basic program setup
- Define crop, location, soil type, Nutrigation™ system
- Easy to use

"Simplicity is the ultimate sophistication."

Leonardo da Vinci

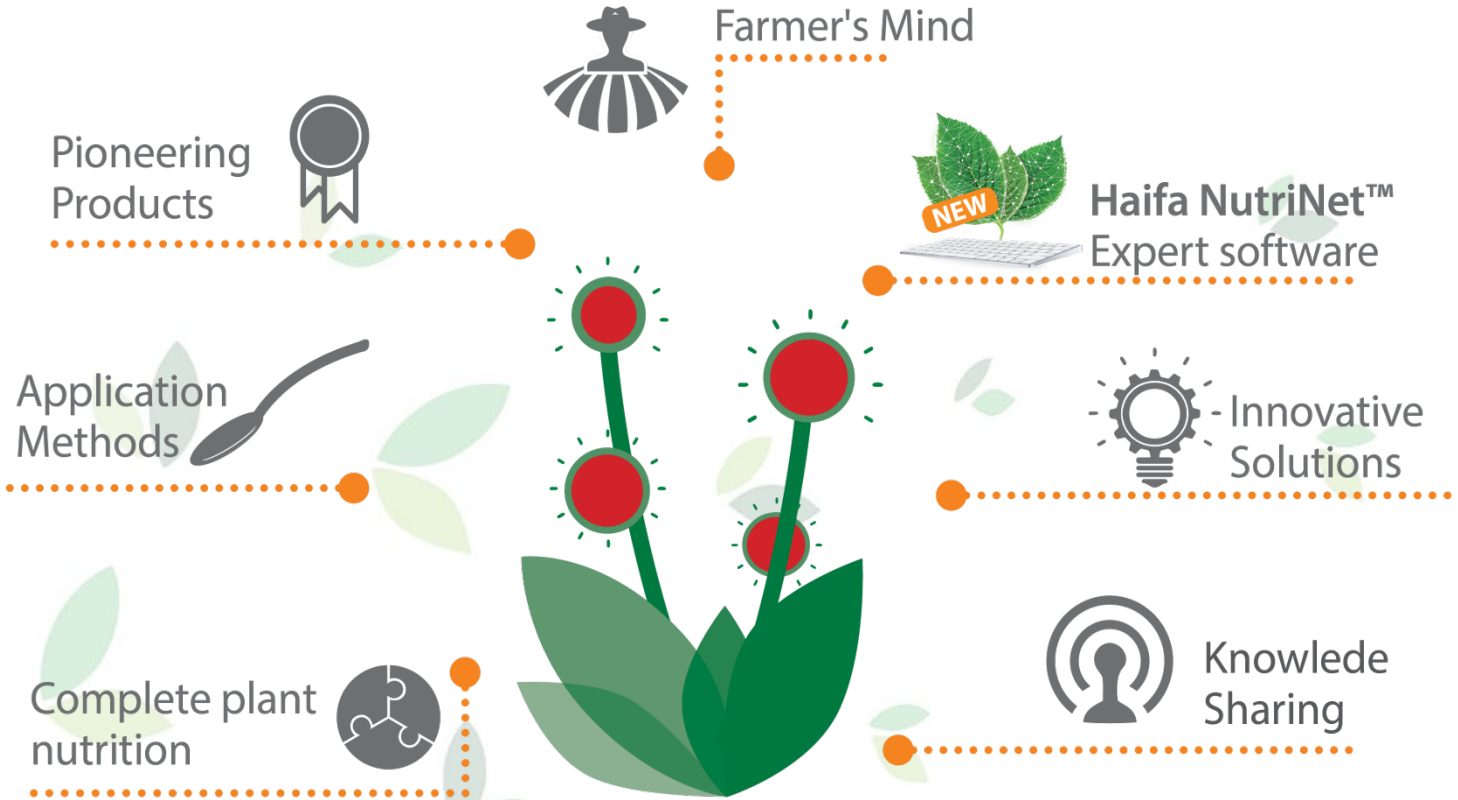


Pioneering the Future Haifa

Summary

- Micro-irrigation saves water
- Micro-irrigation → Nutrigation™
  - Improved nutrients use efficiency
  - Better crop nutrition
- Optimize your Nutrigation™ program
  - Proper planning
  - High quality fertilizers
- Take advantage of Haifa NutriNet™

Plant 360º by Haifa



Thank You

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www.haifa-group.com/community