



Pioneering the Nutrigation™ Way

The Benefits of Nutrigation





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Haifa - Who We Are

We develop, manufacture and market:

▼ Potassium Nitrate for

- ▼ Agriculture
- ▼ Industry
- ▼ Thermo-Solar Power Plants

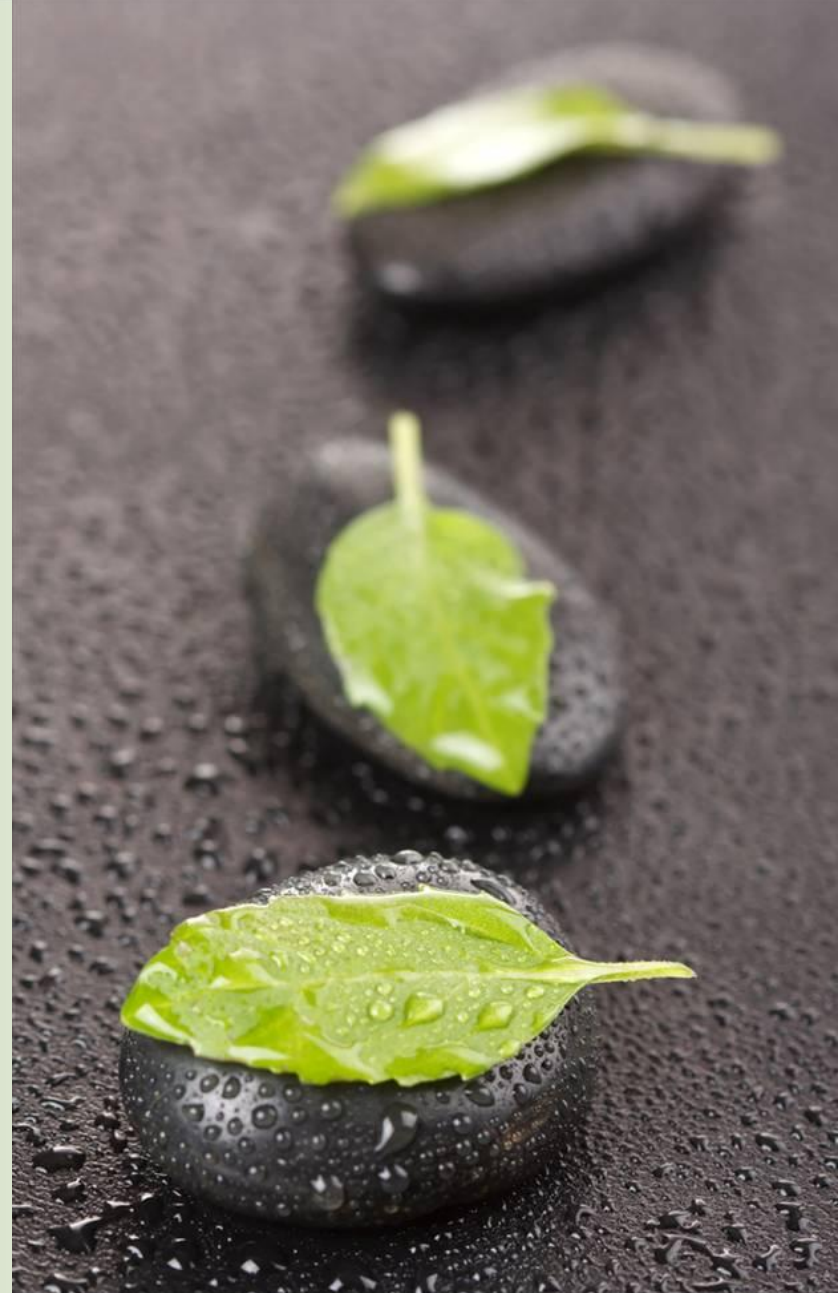
▼ Specialty Plant Nutrients

▼ Food Additives

▼ Technical Chemicals

History, Facts & Figures

- ❖ Israel-based multinational corporation, founded in 1966
- ❖ Owned by an American Holding Company controlled by the Trump Group
- ❖ Annual production of 0.5 million tons of Potassium Nitrate
- ❖ 2 Production Plants in Israel and another one in France, logistic facilities in Europe, warehouses worldwide
- ❖ Annual turnover approx \$700 Million (2010)

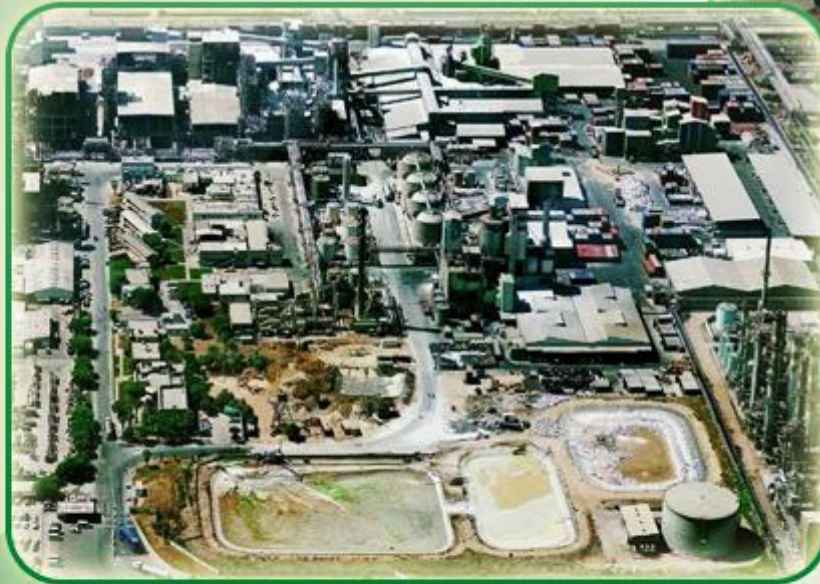


Production Sites



Northern Negev, Israel

Haifa Bay, Israel



Our Global Marketing Network



12 subsidiaries with around 700 employees



Why Nutrigration





Nutrigation = Nutrition + Irrigation

Water and plant nutrients are delivered simultaneously through the irrigation system, in precise combination and timing.

Dynamics of Nutrient Uptake



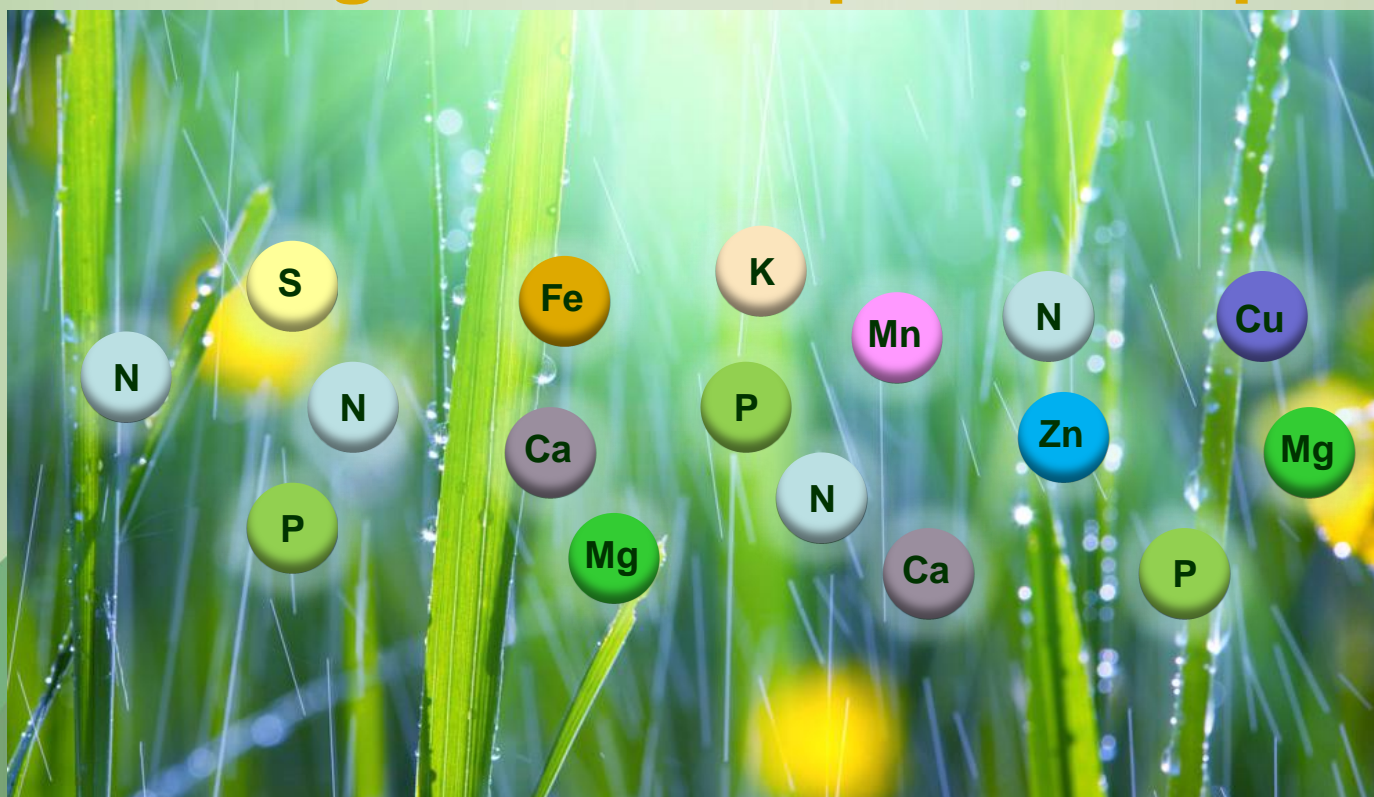
The plant can't handle it's entire annual water portion applied at once



Dynamics of Nutrient Uptake



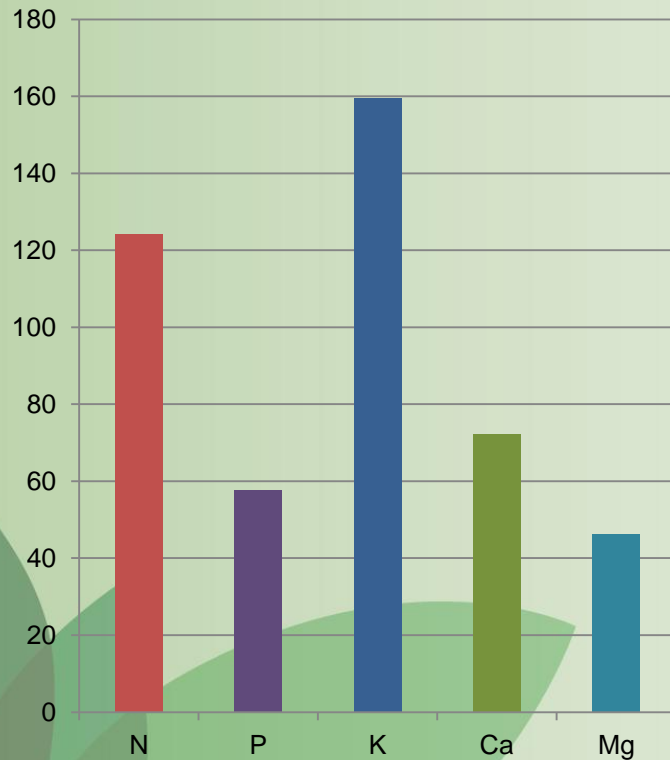
Nutrients, too, should be applied according to their requirement pace



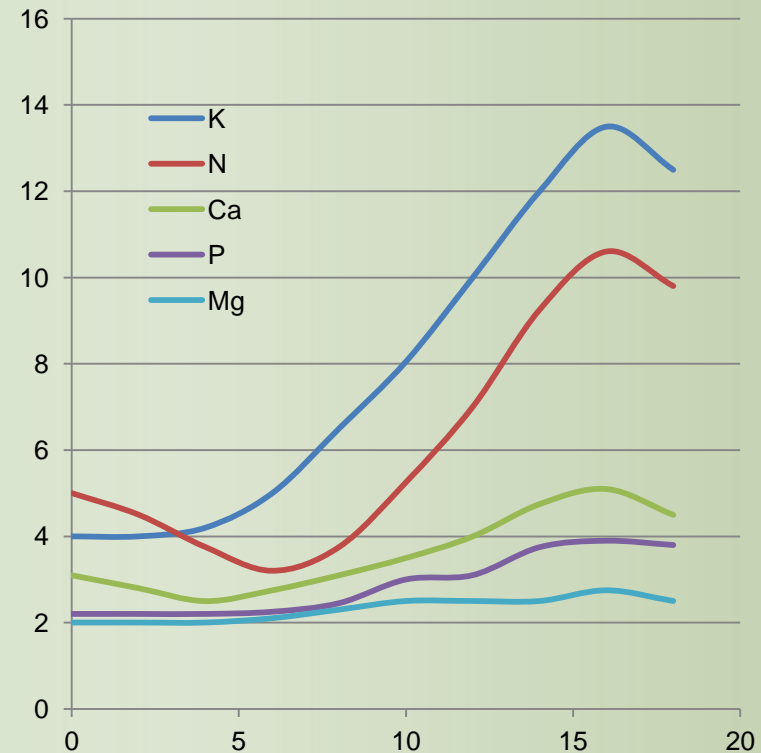


Dynamics of Nutrient Uptake

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.



Dynamics of Nutrient Uptake

Nutrigation enables optimal match between plant requirements and nutrients supply:

- ✓ Precise timing
- ✓ Precise composition
- ✓ Precise rates



The Benefits of Nutrigation



The Benefits of Nutrigation for Plant



- ❖ Nutrients are directed to the active root zone
- ❖ Uniform distribution of nutrients
- ❖ Nutrients are already dissolved, hence ready for uptake by the roots
- ❖ Plant enjoys continuous nutrition. No temporary deficiency may occur



The Benefits of Nutrigation for System



- Reduced losses of nutrients by leaching
- Soil and groundwater contamination is minimized
- Less soil compaction, hence better root performance
- Saving on machine / manual spreading
- Reduced weed population, hence less herbicide costs
- Higher application flexibility (time, weather, soil)

Proven Benefits

Crop: Lily bulbs

Experiment location: Holland, Lisse, LBO trial Station, 1996

Control treatment: Soil applied NPK's

Nutrigation treatment: 17-8-26+2MgO



Application method	Share of bulb sizes >16 (%)	Botrytis infected (%)	Total profit (\$ / ha)
Soil	35.6	6.3	116,785
Nutrigation	62.0	2.0	137,900



Proven Benefits

Crop: “ruby- red” grapefruits

Experiment location: U.S., Florida, 1995

Control treatment: Soil applied Multi-K

Nutrigation treatment: Multi-K



Application method	Total yield (boxes/tree)	Fruit size 40 (boxes/ ha)	Gross packed value (\$ / ha)
Soil	7.9	1060	16,500
Nutrigation	8.8	1446	19,500



Proven Benefits

Crop: Open- field tomatoes

Experiment location: India, Andhra Pradesh, 1997

Control treatment: Soil applied MOP

Nutrigation treatment: Multi-K, equal K rate



Application method	Total yield (MT / ha)	Net benefit over control (\$ / ha)
Side- dressed with MOP	21.0	--
Nutrigated with Multi-K	26.2	215



Pioneering the Nutrigation Way

Haifa's Nutrigation solution promise framers



Precise
Nutrition



Application
Flexibility



Minimized
Losses



Environmental
Protection



Pioneering Solutions

Haifa's Nutrigation
Solutions



Haifa's Nutrigation Solutions



- ✓ Comprehensive range for all crop needs
- ✓ Special products for greenhouses, soilless culture
- ✓ 100% water soluble
- ✓ Contain plant-nutrients only
- ✓ Efficiently absorbed by the plant
- ✓ Free of chloride, sodium, and any other detrimental materials

Haifa's Nutrigation Solutions Potassium Nitrate



Complete range of products:

- ❖ Crystalline Products (Nutrigation, foliar application)
- ❖ Special Grades (greenhouses)
- ❖ Enriched formulas (+ P, Mg, B, Zn, S, Micronutrients)



Haifa's Nutrigation Solutions

Plain Fertilizers



Fertilizers for production of customized nutritional solutions

- Mono-ammonium phosphate
- Mono-potassium phosphate
- Magnesium nitrate
- Calcium nitrate
- Magnesium sulfate
- Potassium sulfate
- Urea phosphate



Haifa's Nutrigation Solutions

NPK Fertilizers



Ready-made combinations for complete nutrition

- ❖ Poly-Feed GG – greenhousegrade
- ❖ Poly-Feed Drip – for open field Nutrigation

All formulae are enriched with full range of plant micro-nutrients



Haifa's Nutrigation Solutions

Micro-nutrients



- Complete plant nutrition
- Prevent and cure deficiencies



Nutrigation

How to Do it Right





Basic Guidelines

- ❖ Nutrients availability should follow plant's requirements
- ❖ Nutrient uptake rates are crop-specific
- ❖ No nutrient can replace another one
- ❖ Nutrients should be available to the plants “Just- on-time”
- ❖ Any deficiency or delay in nutrient availability will result in a reduction in yield and/or quality



Nutrigation Program

Nutrigation program should consider:

❖ Water management

Set up your irrigation plan for the growth season, regarding total quantities, rates and intervals.

❖ Nutrient requirements

Expect uptake rates of plant nutrients throughout the season



Water Management



Good Nutrigation program is based on proper water management, considering:

- ❖ Plant water requirements
- ❖ Soil type
- ❖ Irrigation equipment



Water Management

Plant Water Requirements



Plant water requirements are proportional to the rate of evapo-transpiration (ETP) which depends on

- ❖ Plant type
- ❖ Stage of plant development
- ❖ Meteorological conditions (temp., wind, radiation, humidity)

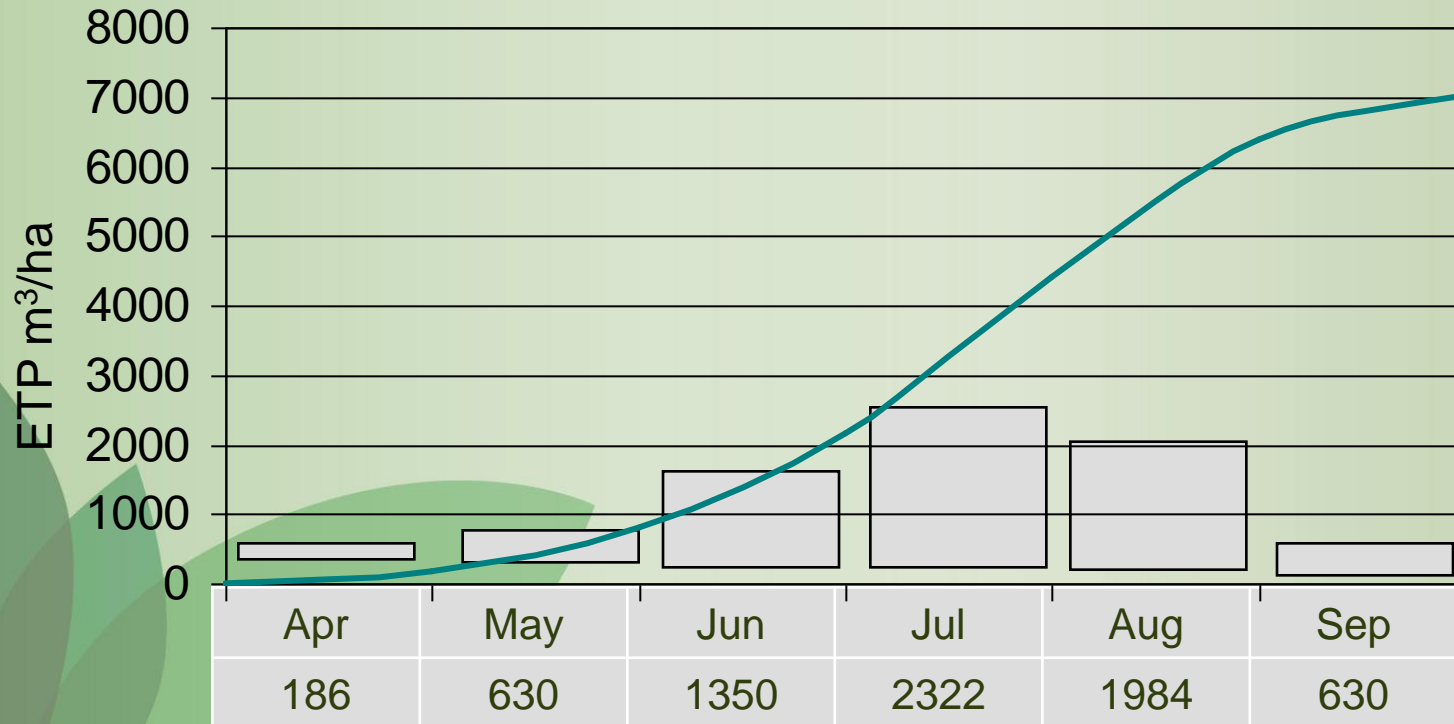
Water Management

Plant water requirements



Example: monthly and cumulative ETP of cotton

Cumulative ETP = total amount of water required

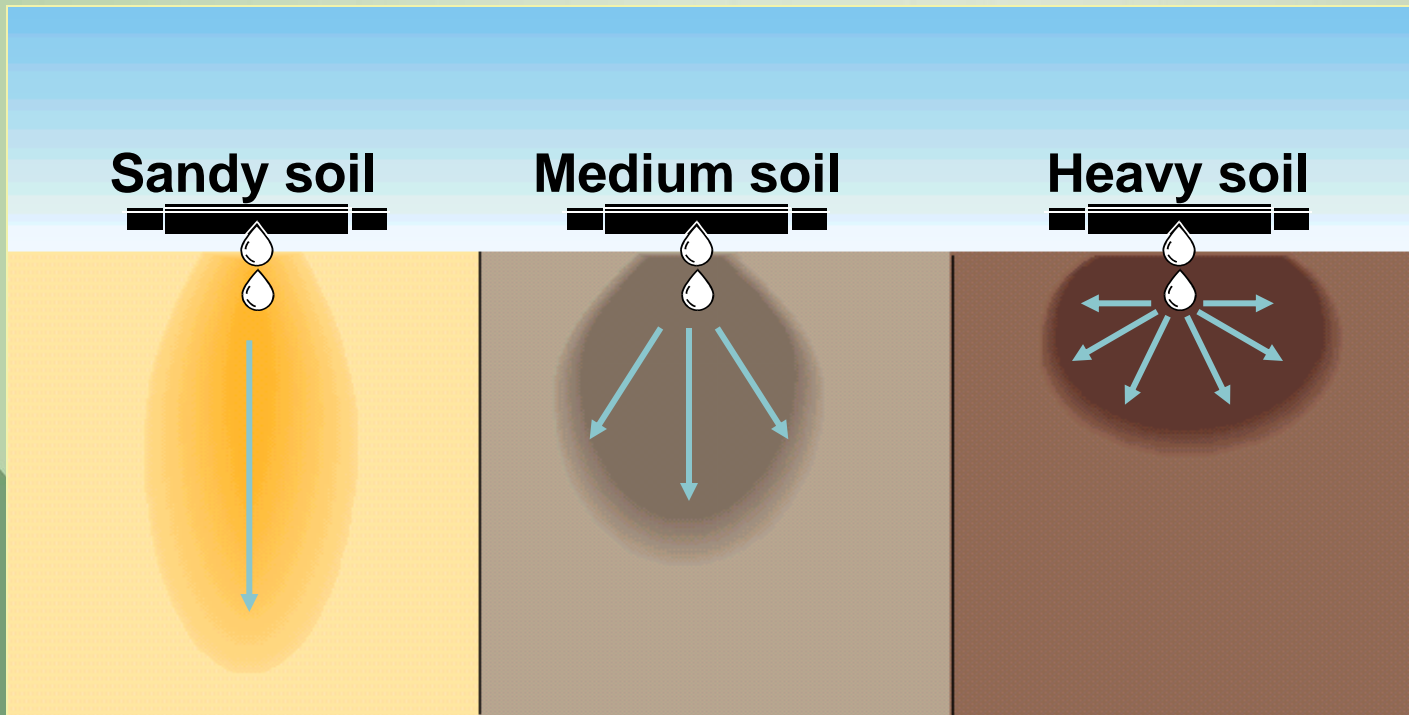


Water Management

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

Water Management

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

Water Management

Irrigation Equipment



Type of irrigation equipment determines daily irrigation portions and time intervals between irrigations.

Examples of irrigation cycles during June in Israel coastal area:

Crop	Daily portion (m ³ /ha)	Time intervals between irrigations (days)			
		sprinkler	Micro jet	Drippers	
				Heavy soil	Sandy soil
Citrus	35	35	12	6	5
Avocado	38	8	5	4	2



Nutrigation = Nutrition + Irrigation

...and now we have to introduce nutrients
into the irrigation water...



Nutrient Requirements

Supply of nutrients should follow plant requirements in terms of

- ❖ Composition
- ❖ Rates
- ❖ Timing

Composition and rates depend on

- ❖ Crop type and growth stage
- ❖ Target yield
- ❖ Plant size and density of population

Nutrigation Methods



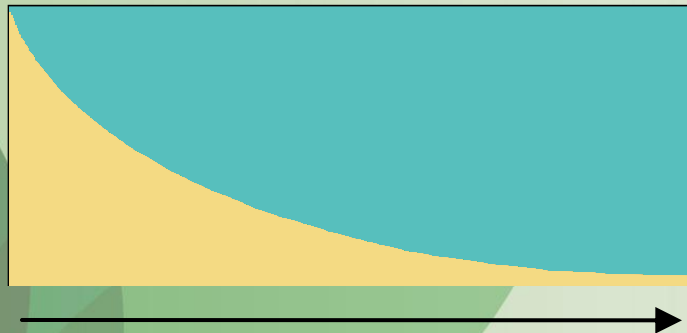


Nutrigation Methods

Quantitative

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

Fertilizer concentration
in the irrigation water



Time

Proportional

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



Time

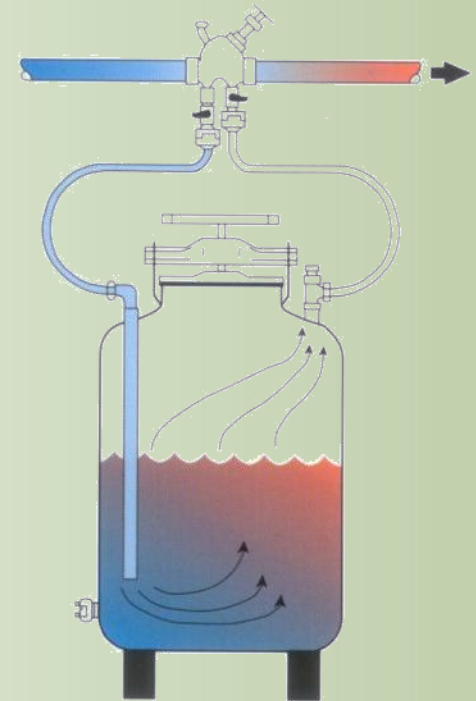
Quantitative Nutrigation



Used in orchards and in heavy soils

- ❖ The grower determines 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.



Quantitative Nutrigation





Quantitative Nutrigation

Advantages:

- ✔ Low cost; simple maintenance
- ✔ No need to pre-dissolve dry fertilizers
- ✔ Allows high discharge rates

Disadvantages:

- ✔ The distribution of the applied fertilizer might not be fully homogenous.



Quantitative Nutrigation

Example of Nutrigation program

- ❖ Crop: tomatoes in tunnels
- ❖ Location: Israel coastal area
- ❖ Soil type: sandy loam
- ❖ Planting density: 18,000
- ❖ Planting on 1.11



Quantitative Nutrigration

Example of Nutrigration program

Tomatoes in tunnels – Nutrigration with Poly-Feed®

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

* All formulae contain micro-nutrients





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 Nutrigration

Example of Nutrigration program

- ❖ Crop: tomatoes in open field
- ❖ Location: Israel
- ❖ Soil type: Sand
- ❖ Target yield: 150 ton/ha
- ❖ Planting on 15.3
- ❖ 1st harvest: 1.5

Proportional Nutrigation



Week	Formula*	Conc. Kg/m ³	ETP mm/day	ETP coeff.	Water m ³ /ha/day	Water m ³ /ha/week	Poly-Feed kg/ha/week	kg/ha/week			ppm N
								N	P ₂ O ₅	K ₂ O	
		r	a	b	c=10xaxb	d=cx7	e=dxr				
1	20-20-20	0.3	4	0.2	8.0	56.0	17.0	3	3	3	60
2		0.4	4.5	0.3	13.5	94.5	38.0	8	8	8	80
3		0.5	4.5	0.35	16.0	11.0	55.0	11	11	11	100
4		0.6	4.5	0.40	18.0	126.0	76.0	15	15	15	120
5	20-9-20	0.7	5	0.45	23.0	158.0	110.0	22	10	22	140
6		0.7	5	0.5	25.0	175.0	123.0	25	11	25	140
7		0.7	5.5	0.5	28.0	193.0	135.0	27	12	27	140
8	17-10-27	0.7	6	0.6	36.0	252.0	176.0	30	181	48	119
9		0.7	6	0.8	48.0	336.0	235.0	40	24	64	119
10		0.7	6.5	0.8	52.0	364.0	255.0	43	25	69	119
11		0.7	7	0.8	56.0	392.0	274.0	47	27	74	119
12		0.7	7.5	0.8	60.0	420.0	294.0	50	229	79	119
13		0.7	8	0.8	64.0	448.0	314.0	53	31	85	119
14		0.7	8	0.8	64.0	448.0	314.0	53	31	85	119
15		0.7	8	0.7	56.0	392.0	274.0	47	27	74	119
16		0.7	8	0.5	40.0	280.0	196.0	33	20	53	119
17		0	8	0.2	16.0	112.0	0	0	0	0	0
Total						4360	2890	510	300	740	

* All formulae contain micro-nutrients



Proportional Nutrigation - Venturi (bypass)

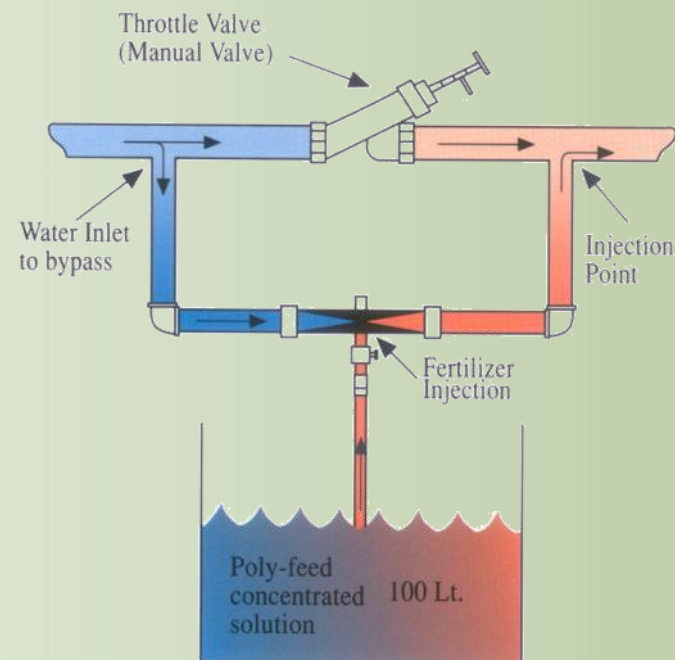


Advantages:

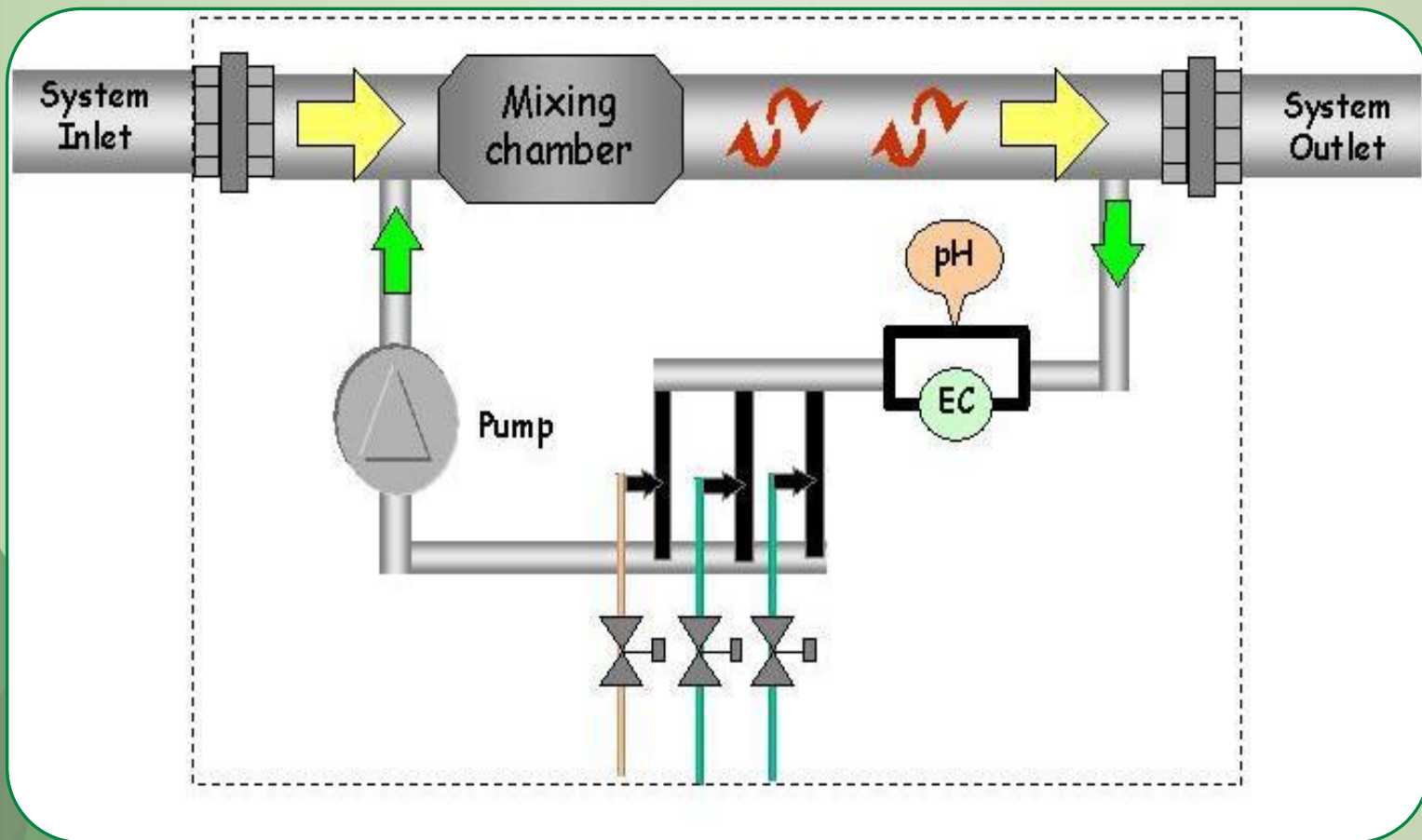
- Relatively inexpensive and
- simple to maintain.
- Size of orifice controls fertilizer
- concentration.

Disadvantages:

- High loss of pressure if installed
- directly on main pipeline
- Relatively low discharge rate



Proportional Nutrigation – Venturi (bypass)



Proportional Nutrigation - Powered Fertilizer Pump



Power may be either electrical or hydraulic

Advantages:

- Very flexible discharge rates
- Negligible loss of pressure
- Fine control over fertilizer concentration
- Allows automated control

Disadvantages:

- Expensive
- Complicated to maintain, requires skilled operator



Proportional Nutrigation – Powered Fertilizer Pump



Proportional Nutrigation

Simple Proportional Nutrigation Methods:

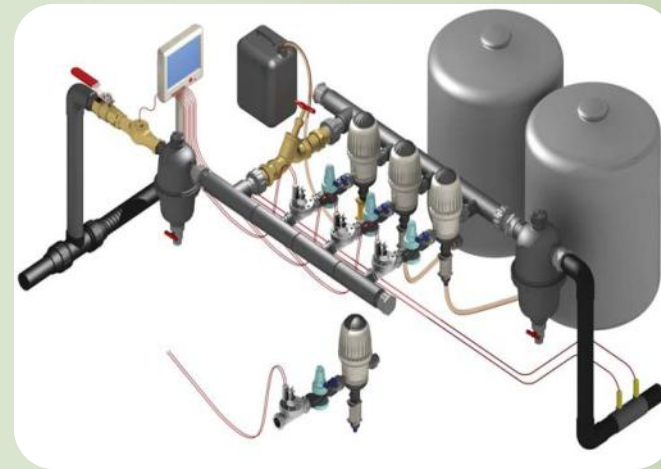
- ✔ Proportional injection pumps
- ✔ Fix ratio between tanks A+B+C
- ✔ No EC and pH control or monitoring



Proportional Nutrigation

Sophisticated Proportional Fertigation and irrigation control unit

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



Proportional Nutrigation

- ❖ Combined unit for irrigation control and fertilizers injection.
- ❖ Flexible programming including EC & pH, proportional fertigation and irrigation control.
- ❖ Pulse irrigation



Nutrigation by a Pivot in large scale open fields



Overhead Nutrigation



Nutrigation by a Pivot in large scale open fields



- ❖ Dissolved fertilizers are injected into supply pipeline
- ❖ Less risk of clogging due to big outlets/holes and high water volume
- ❖ Micro climate is prevailing under hot conditions (an advantage for “mild temp.” crops such as potato, onion, garlic)
- ❖ Nutrients are absorbed through the leaves as well (effect of foliar nutrition)
- ❖ Stock tanks may be either static or mobile
- ❖ limitation on fertilizers concentration in Centre Pivots as the first span in a pivot is very low flow rate (prevent leaf burns).

Nutrigation by Pivot in a large scale open field



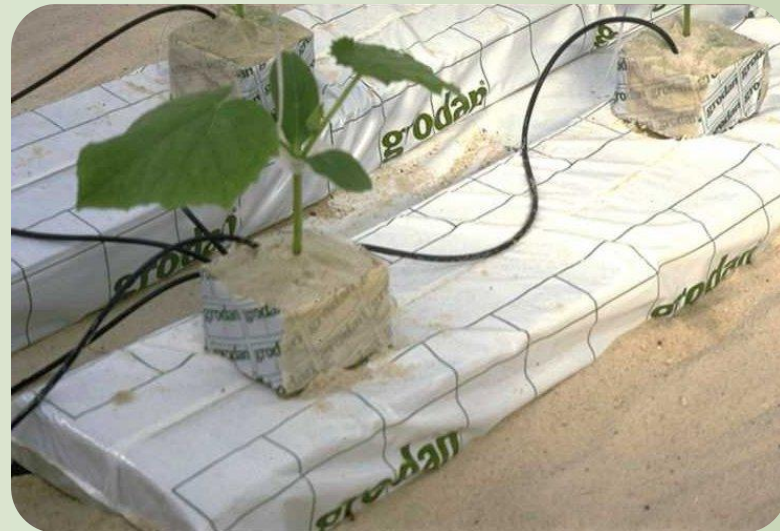
Nutrigation in Soilless Media



Nutrigation in Soilless Media

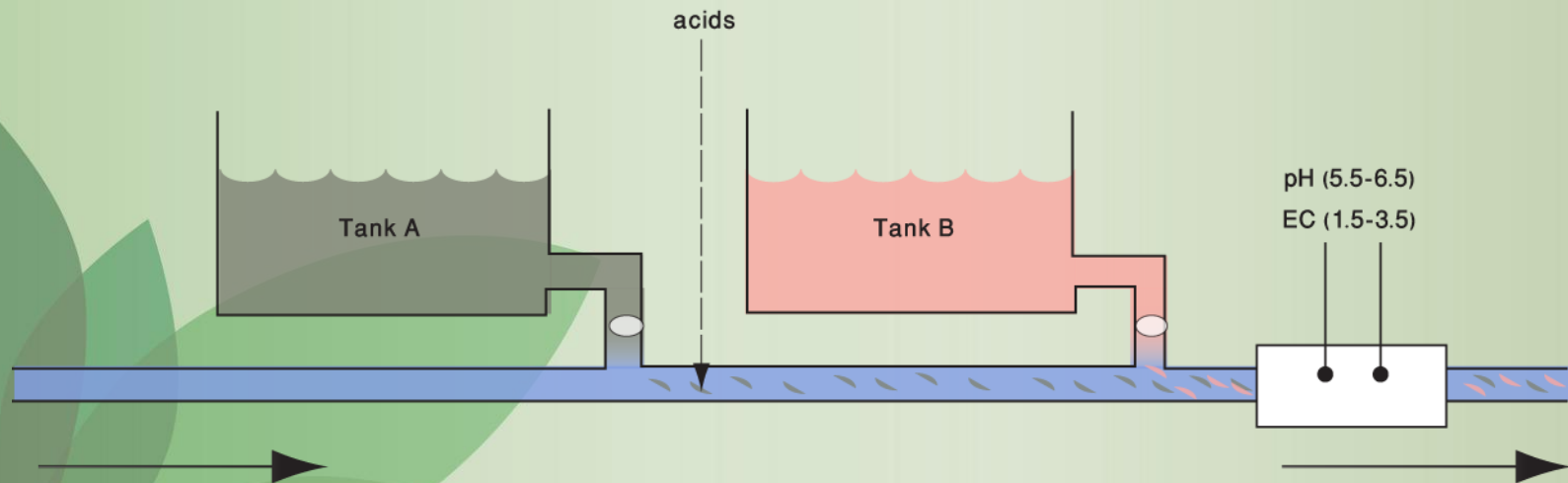
Characteristics of the system:

- ❖ Limited volume - frequent irrigation
- ❖ Inert medium - fertilization whenever irrigating
- ❖ Limited root mass - high sensitivity to water and nutrient deficiencies
- ❖ Intensive supervision



Nutrigation in Soilless Media

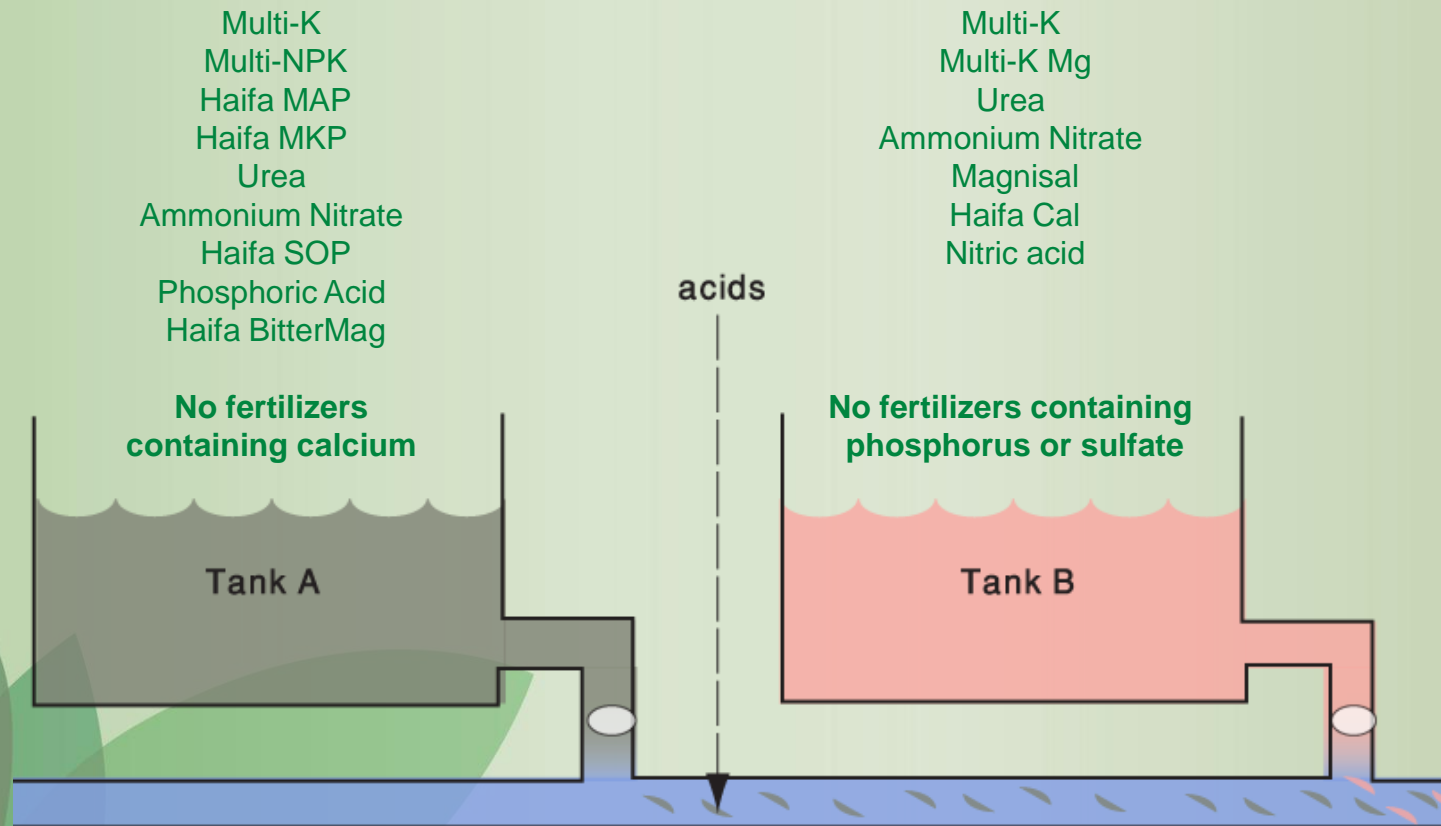
- ❖ Fertilizers must be of top quality and highest purity
- ❖ Nutritional composition must be accurate
- ❖ EC and pH must be monitored and adjusted to ensure proper growth conditions
- ❖ Two-Tank method is employed to prevent formation of precipitates





Nutrigation in Soilless Media

Two-Tank system*



* Two-Tank system is also used for soil Nutrigation

Nutrigation in Soilless Media



Two-Tank system





Nutrigation - Summary

- ✓ Enables optimal nutrition according to plant's needs
 - ✓ Provides plant nutrition at precise compositions and rates
 - ✓ Feeds plants continuously with no temporary deficiencies
 - ✓ Nutrients are applied directly to the active root zone
- ✓ Nutrients use efficiency is maximized, with minimum losses
- ✓ Soil and groundwater contamination is minimized
- ✓ Saving on machine / manual spreading
- ✓ High application flexibility (time, weather, soil)



Pioneering the Nutrigation Way

Haifa's Nutrigation solution promise framers



Precise
Nutrition



Application
Flexibility



Minimized
Losses



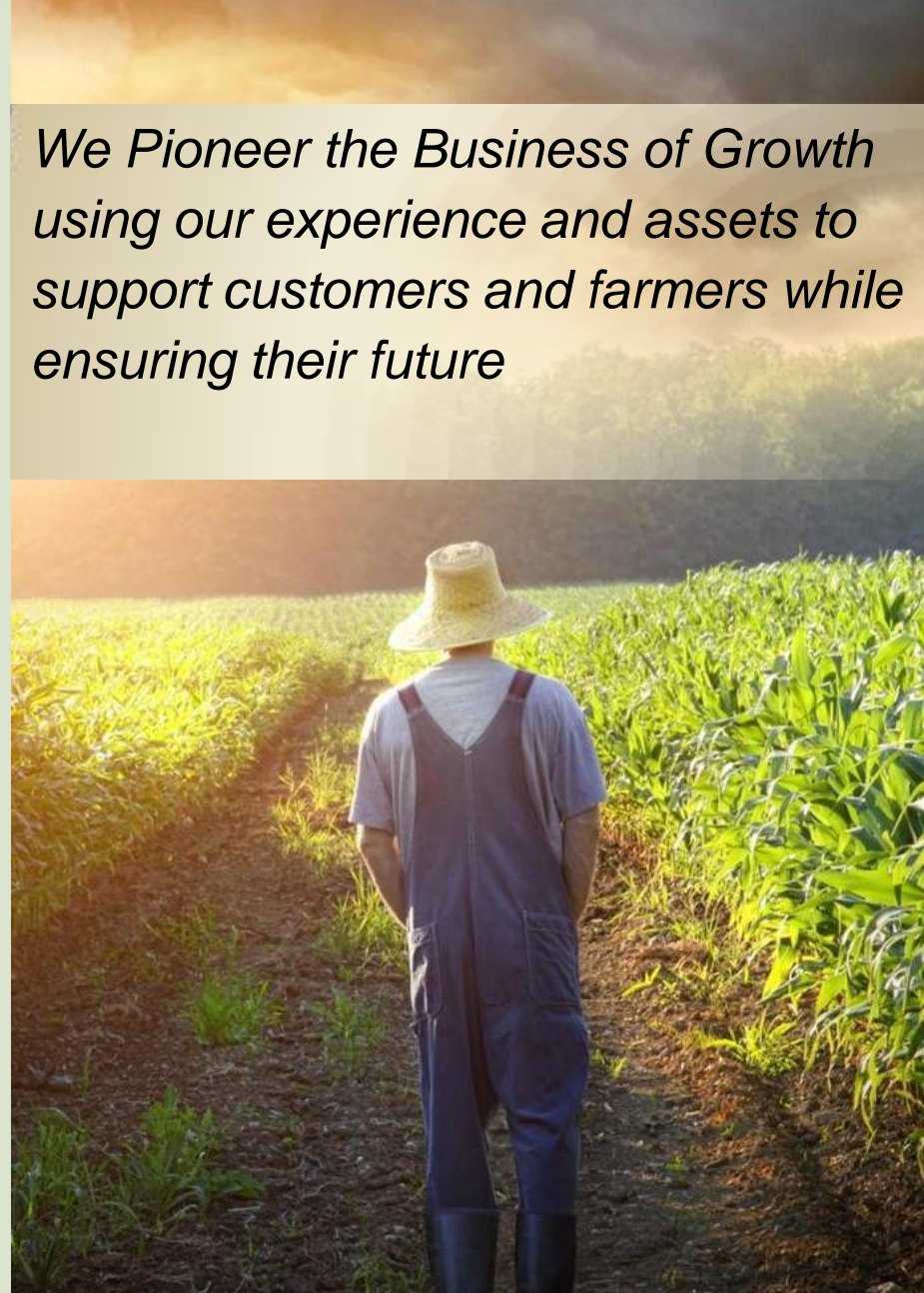
Environmental
Protection



The Haifa Edge

- ✔ Industry Pioneer and world expert in Specialty Fertilizers
- ✔ Focus on Farmers - their interests and benefits
- ✔ Solid, stable company with massive global presence
- ✔ Top quality operation standards
- ✔ Committed to well-being of employees, customers, community and the environment

We Pioneer the Business of Growth using our experience and assets to support customers and farmers while ensuring their future





Thank You

Join our community

www.haifa-group.com/community

