



Foliar Nutrition with Haifa Products





Contents

- ❧ Foliar feeding – why and when
- ❧ The mechanism of foliar nutrition
- ❧ Practical guidelines
- ❧ Haifa foliar solutions





Foliar Nutrition Why & When





Foliar Feeding – why and when

- ❖ **Complementary fertilization** with high added value
- ❖ **Corrective nutrition** when deficiencies are noticed
- ❖ **Growth boosting** during critical stages of plant development
- ❖ “Special jobs”
 - ❖ **Dormancy breaking** (in vineyards and deciduous trees)
 - ❖ **Flower induction** (in mango)



Complementary nutrition

Foliar application of nutrients complements soil application or Nutrigation:

❖ **When root uptake is disturbed**

- ❖ Sub-optimal soil conditions: low soil temperature, poor aeration, water logging....
- ❖ Roots damage because of diseases or nematodes

❖ **When soil fertilization is inadequate**

- ❖ **Application of nutrients with restricted mobility in the phloem, such as Ca, B, Fe, Mn or Zn**



Corrective nutrition

Foliar uptake of nutrients is much faster than root uptake.

Foliar fertilization is recommended:

- ✦ When deficiency symptoms are noted
- ✦ When prompt correction of deficiencies is required
- ✦ If root activity is disturbed during the reproductive phase

Nutrients absorbed through the foliage strengthen the plant and help recovering root uptake.



Growth boosting

- ❖ **Certain plant development stages are of higher importance in determining final yields.**
- ❖ **Foliar application of nutrients during these critical stages will**
 - ❖ Increase yields
 - ❖ Improve yield quality

Dormancy breaking

In vineyards and deciduous trees

- ❖ In warm climates, spraying dormancy breaking agents (oils) is a common practice to improve yields
- ❖ Foliar application of **Haifa Bonus** prior to oil spray
 - ❖ Allows reduction of oil application rates, thus reducing costs and minimizing the risk of phytotoxicity
 - ❖ Produces earlier and more uniform dormancy breaking
 - ❖ Results in earlier and more bountiful first harvest wave



Flower induction

In mango



Foliar application of Haifa Bonus induces flowering in mango, thus

- ❖ Increasing yields
- ❖ Overcoming the biennial bearing pattern





The Mechanism of Foliar Nutrition





The mechanism of foliar nutrition

Stages in foliar uptake of nutrients:

- ✦ **Penetration** through cuticle or stomata
- ✦ **Translocation:** transport of ions from cell to cell and through vascular channels (phloem, xylem) from the leaves to sites where they are consumed





Penetration of nutrients into the leaf

Possible pathways:

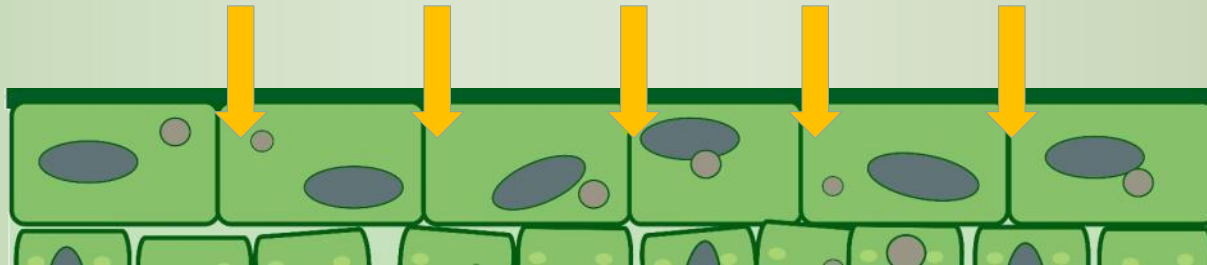
- ❖ Passive diffusion across the cuticle
- ❖ Through stomata
- ❖ Through polar pores (aquaporines)



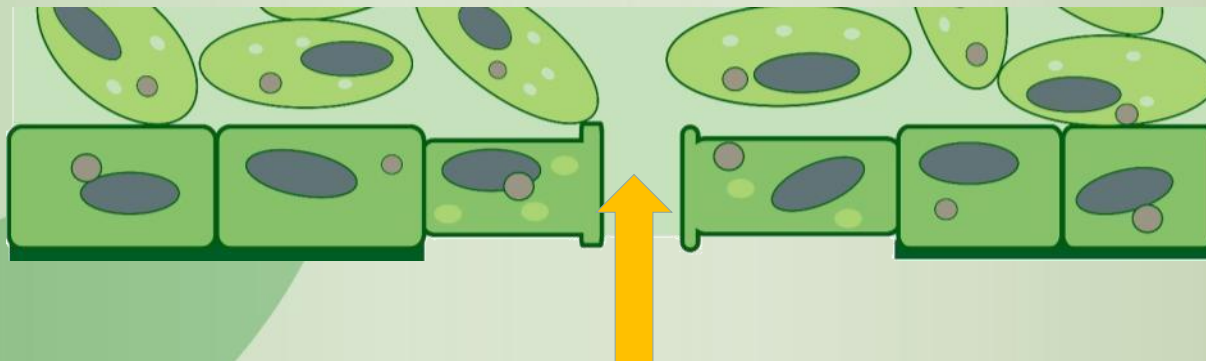
Penetration paths



Through cuticle



Through stomata



Schematic cross-section of leaf

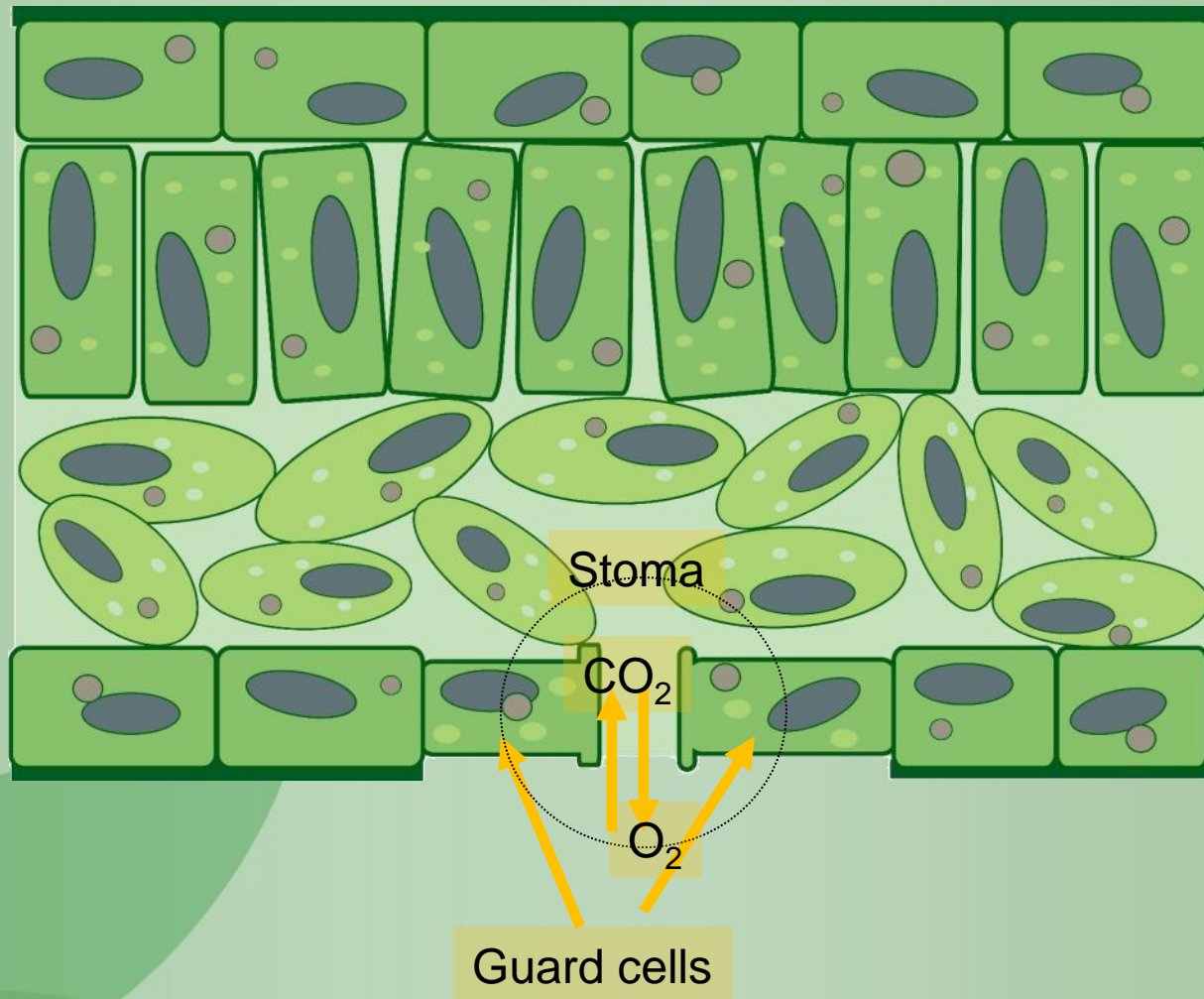


Cuticle
Upper epidermis

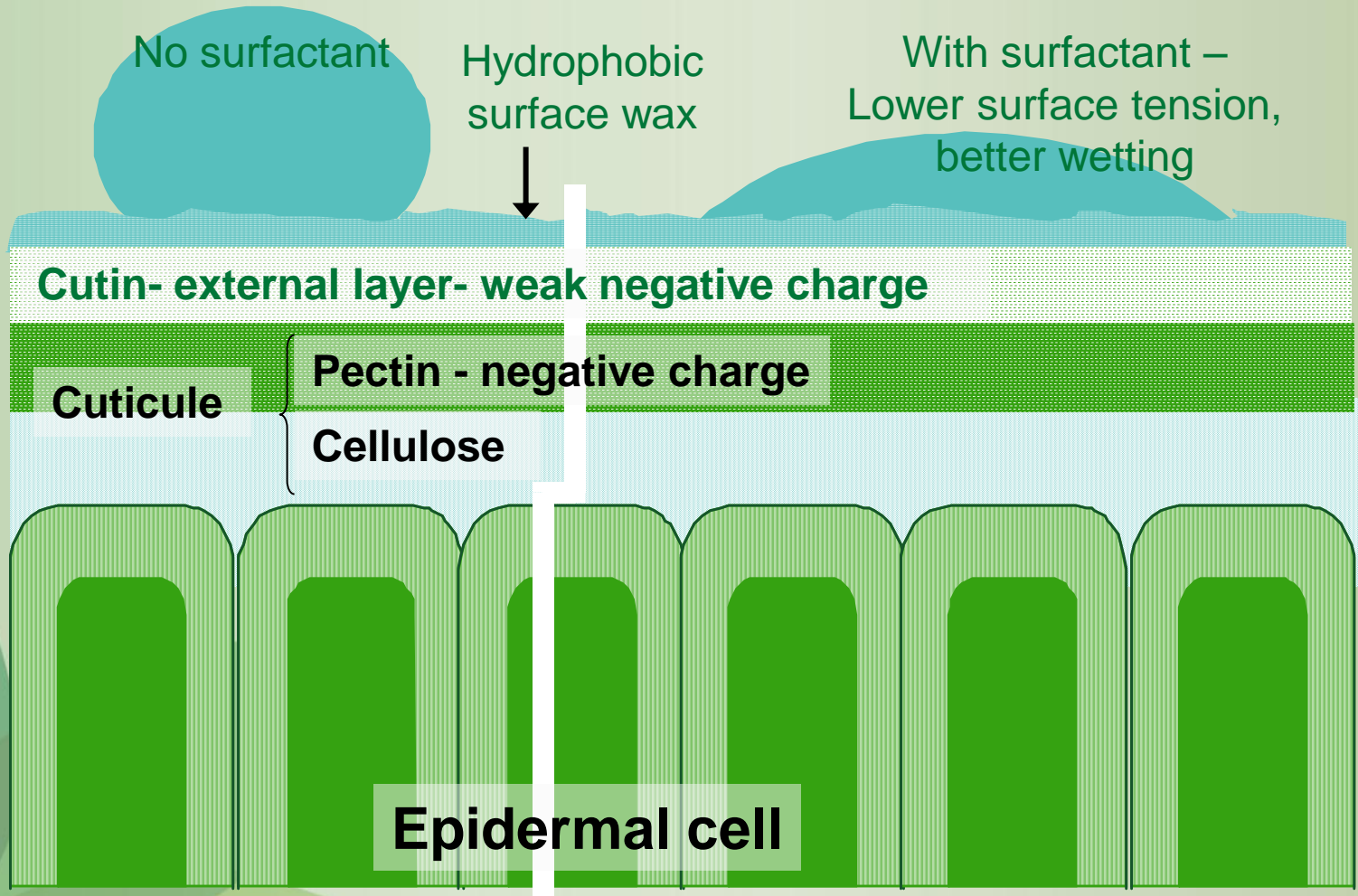
Palisade
mesophyll

Spongy
mesophyll

Lower epidermis
Cuticle



Penetration through cuticle and epidermal cell wall

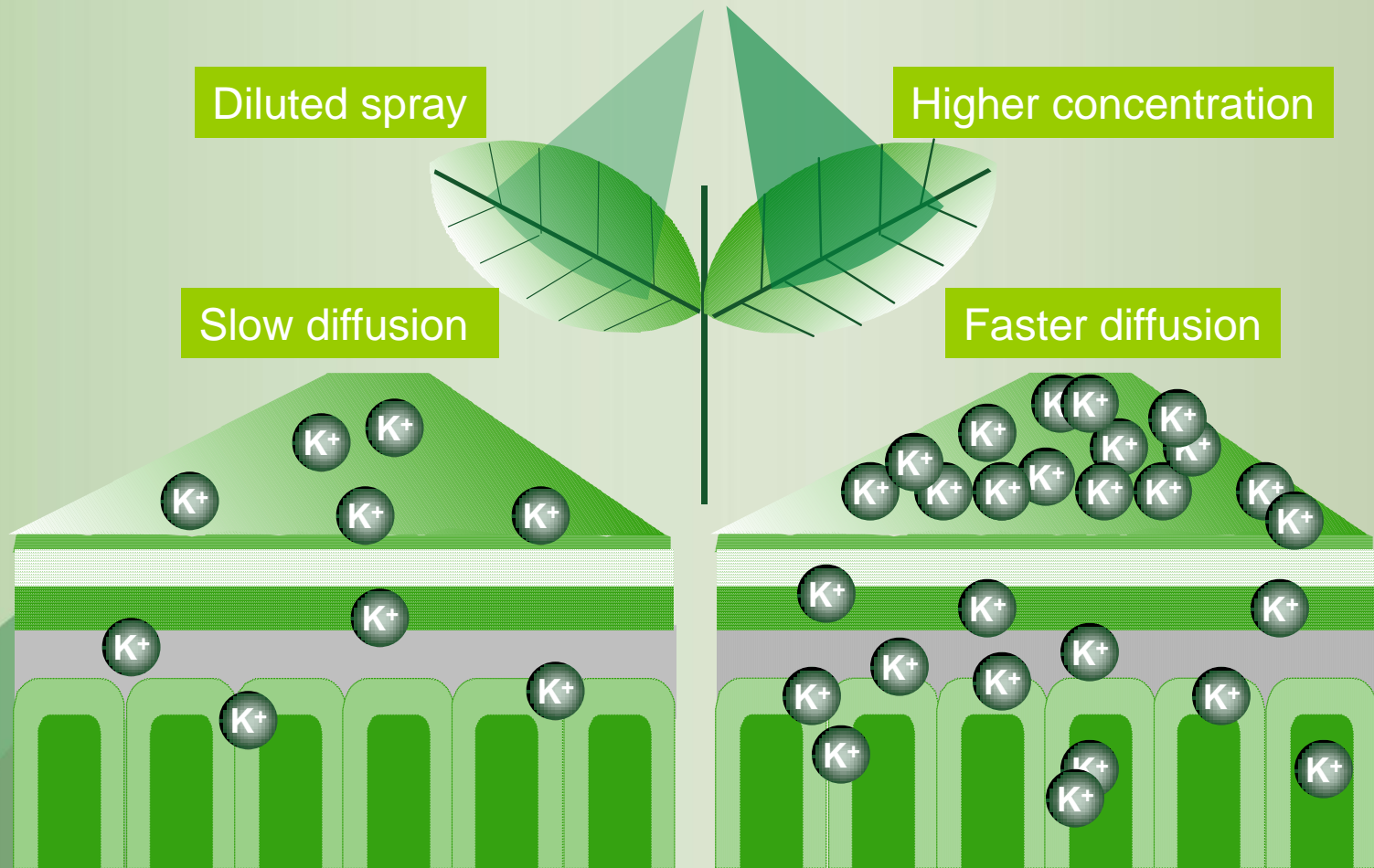




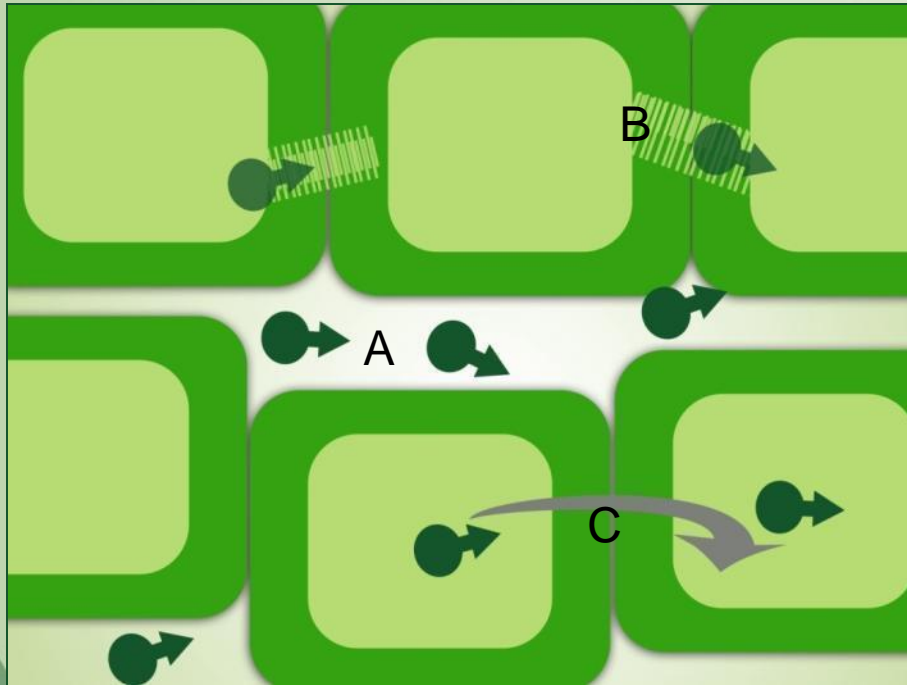
Penetration by passive diffusion

- ✦ It is thought that passive diffusion is responsible for the majority of the penetration
- ✦ Uptake rate depends on solute concentration on the leaf surface
- ✦ Concentration depends on
 - ✦ Spray concentration
 - ✦ Relative humidity (that determines the rate of water evaporation from the sprayed solution)
- ✦ Efficiency of uptake by passive diffusion improves
 - ✦ As the rate of solute that can be applied to leaf surface without causing damage is higher
 - ✦ As the time it remains in active state on the leaf surface is longer

Passive diffusion: uptake is proportional to spray concentration



Ion absorption by the cytoplasm membrane surface



Cell-to-cell transport via

A. Diffusion

B. Absorption by cytoplasm membrane surface

C. Active, energy-consuming transport



Transport through vascular channels

- ✦ Responsible for convection of nutrients to remote parts of the plant
- ✦ **Symplastic movement** – through phloem
- ✦ **Apoplastic movement** – through xylem

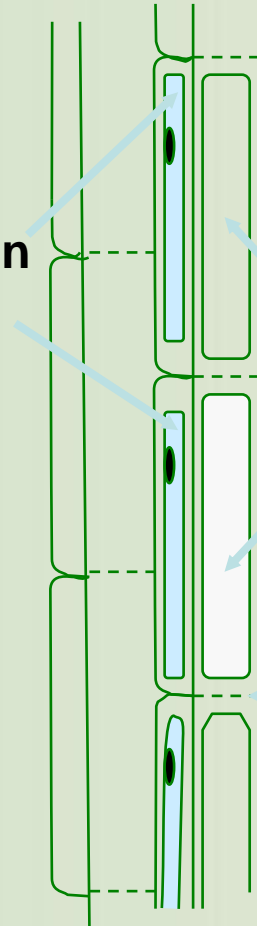


Transport through vascular channels



Phloem

Companion cell



Phloem sieve tube

Sieve plate



Transport through vascular channels

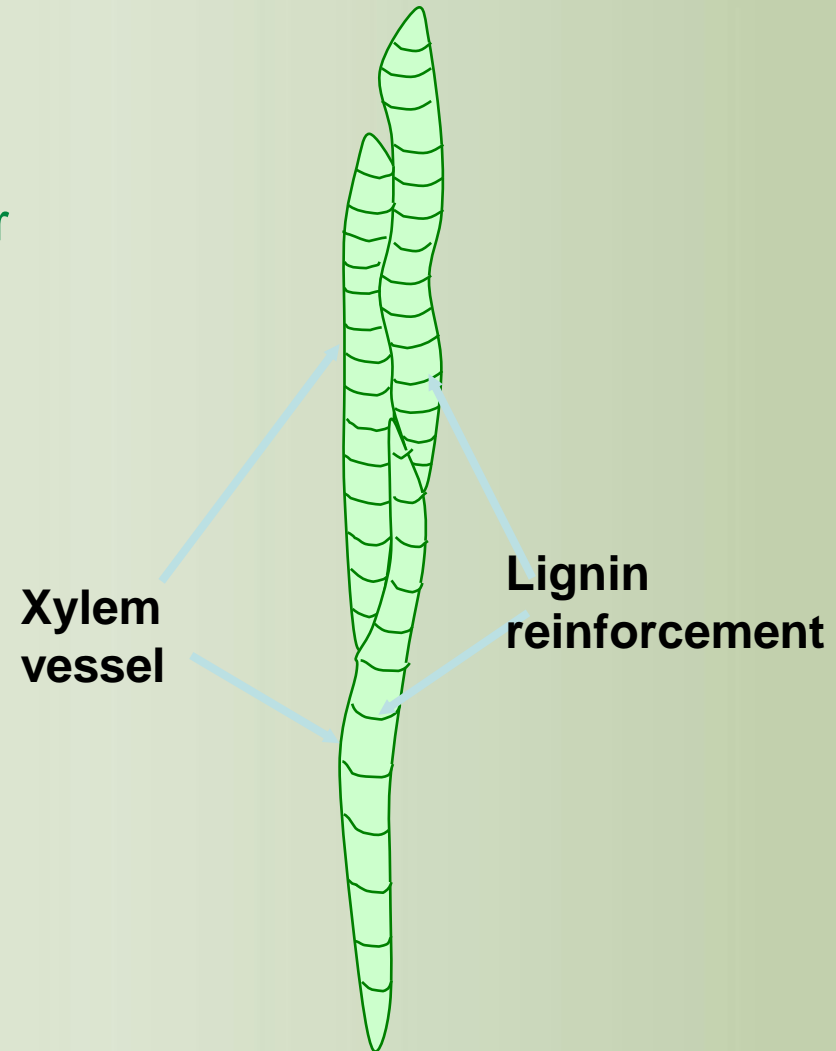
Phloem (symplastic movement):

- ❖ Requires energy
- ❖ More suitable for cations
- ❖ Translocation of anions is very limited, as the cell wall is negatively charged.
- ❖ Movement regularly follows the 'sink-source' relationship: Ions are transported from sites where carbohydrates are synthesized ('source' - mature leaves), to sites where they are consumed ('sink' - developing flowers and fruits, growing tips in the roots and shoots).

transport through vascular channels

Xylem (apoplastic movement):

- Regulated by the xylem flow.
- The driving force for this flow is water potential differences between soil, leaf and atmosphere.
- The xylem flow is controlled by transpiration during the day, and by root pressure at night.





Foliar Nutrition Practical Guidelines



Successful foliar fertilization

General

- Spray during the cooler and more humid times of the day
- Spray when wind is low
- Never spray plants under stress
- Test for possible side-effects or phytotoxicity by a small trial, spraying a week prior to the intended commercial treatments
- After spraying rinse thoroughly the sprayer and all its parts with fresh water





Successful foliar fertilization

Preparation of tank mix

- ❖ Fill 1/4 - 1/3 of the spray tank with water. Add the entire amount of the fertilizer(s) and then fill up the tank with water.
- ❖ When preparing tank mix that includes pesticides, it is advisable:
 - ❖ To keep the pH of the spray solution at level of 5.5 -6.5, to avoid alkaline hydrolysis of the pesticides.
 - ❖ To perform a compatibility test of the spray-mix prior to large-scale treatment.





Successful foliar fertilization

Setting application rates

- ✔ Consider both spray concentration and spray volume.
- ✔ If you apply smaller (or larger) volume than recommended, increase (or decrease) the fertilizer concentration of the spray solution accordingly, to keep the total application rate per unit of area.
- ✔ Avoid too concentrated sprays, as they might scorch leaves.





Successful foliar fertilization

Setting application rates (cont.)

- ✦ In general, effective foliar nutrition requires application rates of at least 20-40 kg Haifa-Bonus™ npK or Poly-Feed® Foliar per hectare per season.
- ✦ Plants in areas of humid climate tend to have thinner leaf cuticle, which make them more susceptible to phytotoxicity.
For this reason, spray concentrations must be considered more cautiously in these areas.





Haifa Foliar Solutions



Haifa's foliar solutions



- ✓ A selection of premium products for foliar application
- ✓ 100% water soluble
- ✓ Contain plant-nutrients only
- ✓ Efficiently absorbed by the plant
- ✓ Free of chloride, sodium, and any other detrimental materials





Haifa's foliar solutions

- ✓ **Haifa Bonus** high-K foliar formulae
- ✓ **Poly-Feed Foliar** NPK formulae, enriched with micro-nutrients
- ✓ **Magnisal** magnesium nitrate
- ✓ **Haifa MAP**
- ✓ **Haifa MKP**
- ✓ **Haifa Protek**
- ✓ **Haifa Micro** chelated microt-nutrients





Haifa Bonus

- High-K foliar formulas
- Specially designed to allow for concentrated sprays
- Based on Multi-K[®] potassium nitrate
- Enriched with phosphorus
 - To enhance nutritional value
 - To keep pH at the optimal level for foliar absorption
 - For improved compatibility with pesticides
- Contains special adjuvant
 - For better adhesion to the leaf surface
 - For improved absorption
 - For prolonged action



Haifa Bonus – how it works



1. Haifa-Bonus™ npK is applied by foliar spray and forms droplets on the leaf

Haifa Bonus – how it works



2. Portion of the fertilizer is absorbed immediately.

Haifa Bonus – how it works



3. When the air gets hot and dry, the fertilizer droplets dry up and nutrient uptake temporarily discontinued.

Haifa Bonus – how it works



4. At night, the dew re-dissolves the fertilizer and nutrient uptake is renewed.

Poly-Feed® Foliar



- ✓ A selection of NPK foliar formulas
- ✓ All contains high concentrations of micronutrients in the form of EDTA chelates.
- ✓ Designed to nourish crops with their exact needs during critical growth phases
 - ✓ Boost yields
 - ✓ Improve quality
- ✓ Based on low-biuret urea



Poly-Feed® Foliar



Stage-specific formulas

	Micronutrients (ppm)					
	Fe	Mn	Zn	Cu	Mo	B
Vegetative Booster 21-21-21	1300	660	200	140	90	200
Flowering Booster 8-52-17	500	250	75	55	35	100
Fruiting Booster 16-8-34	1200	600	180	130	80	200

Poly-Feed[®] Foliar



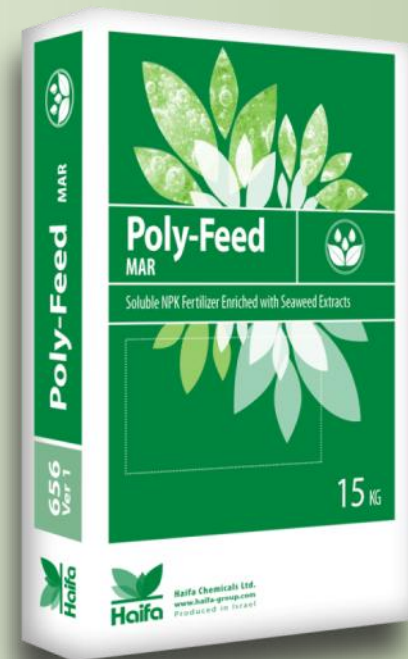
Crop-specific formulas

	Micronutrients (ppm)					
	Fe	Mn	Zn	Cu	Mo	B
Poly-Wheat 23-7-23	1700	850	250	1000	110	200
Poly-Potato 12-5-40	2000	1000	300	220	140	300
Poly-Citrus 16-7-30+2MgO	1000	500	2000	110	70	300
Poly-Olive 15-7-30+2MgO	1000	500	150	110	70	4500
Poly-Rice 15-15-30	1000	1500	150	110	70	200
Poly-Vineyard 4-15-37+3MgO	2300	500	150	110	70	200
Poly-Cotton 12-5-40	2000	1000	300	220	140	300
Poly-Sugarbeet 15-7-30+2MgO	1000	500	150	110	70	4500

Poly-Feed[®] MAR



- ✔ NPK formulas enriched with 0.5%-1% seaweed extracts, that contain
 - ✔ Nutrients
 - ✔ Growth bio-stimulants
 - ✔ Conditioners
- ✔ Enhance plant development
- ✔ Improve soil properties



Magnisal®



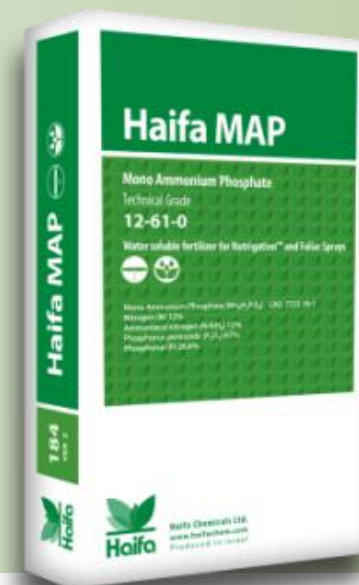
- Magnesium nitrate formula, 11-0-0+16MgO
- Provides the magnesium required for healthy development
 - Component of the chlorophyll molecule
 - Essential for photosynthesis and formation of carbohydrates
 - Involved in enzymatic reactions
- Cures and prevents magnesium deficiencies



Haifa MAP



- Fully water-soluble mono-ammonium phosphate 12-61-0
- Highly efficient source of phosphorus and nitrogen
- Recommended for use at the beginning of the growing season
- P availability is crucial for the establishment of root system
- Double action:
 - Source of N and P nutrition
 - Stabilizing the pH of the spray solution at ~ 5.5, ideal for tank mixes that contain pesticides



Haifa MKP



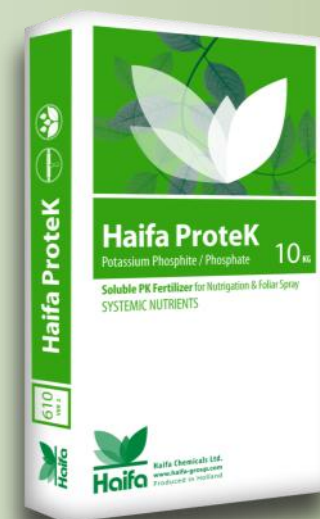
- ✓ Fully water-soluble mono-potassium phosphate 0-52-34
- ✓ Nitrogen-free source of phosphorus, ideal when N fertilization should be limited
- ✓ Helps increasing sugar contents of sugar-rich fruits
- ✓ Triple action
 - ✓ Source of N and P nutrition
 - ✓ Stabilizing the pH of the spray solution at ~ 5.5, ideal for tank mixes that contain pesticides
 - ✓ Helps suppressing Powdery Mildew diseases



Haifa ProteK



- ✔ Systemic P-K fertilizer
- ✔ Contains phosphorus in the form of phosphite for better uptake
- ✔ Enhances vegetative growth and root development
- ✔ Increases fruit size and total yields
- ✔ Improves resistance against various diseases
- ✔ Uniquely formulated as a crystalline product



Haifa Protek



Available products

	Standard	Total
Phosphate (P_2O_5)	26%	-
HPO_3^{2-}	30%	60%
K_2O	37%	39%
K	30.7%	32.4%
pH (1% solution)	4.5-5	4-4.5
Bulk density	0.95 g/cm ³	0.8 g/cm ³

Haifa Micro



- A line of water-soluble chelated micronutrients
- Highly stable and readily available for plants
- Dissolve rapidly and completely, no risk of clogging of spray nozzles



Haifa Micro



Available products

Multi-Micro [®] Fe	Iron-EDTA 13%
	Iron-EDDHA 6%
Multi-Micro [®] Mn	Manganese-EDTA 13%
Multi-Micro [®] Zn	Zinc-EDTA 14%
Multi-Micro [®] Cu	Copper-EDTA 14%
Multi-Micro [®] Comb	7.1% Fe, 3.48% Mn, 1.02% Zn, 0.76% Cu, All as EDTA chelates 0.485% Mo as ammonium molybdate



Foliar nutrition with Haifa Products: Proven results

Numerous field trials, demo plots and commercial-scale applications have proven the efficiency of Haifa foliar fertilizer in

- ♥ Increasing yields
- ♥ Improving various quality indices
- ♥ Preventing nutritional deficiencies
- ♥ Supporting dormancy breaking (in vineyards and deciduous trees)
- ♥ Enhancing flower induction (in mango)
- ♥ Improving fruit storability

Trials have been carried out worldwide, on variety of **field crops**, **vegetables** and **fruit trees**

Contact Haifa representative for more information about foliar nutrition of the crops you grow



Foliar nutrition with Haifa Products: Proven results



- ✔ Highly beneficial, cost-effective plant nutrition
- ✔ Offers high nutrients use efficiency
- ✔ Supports growth and helps overcoming sub-optimal conditions
- ✔ Haifa offers a selection of foliar fertilizers, covering the whole range of plant nutrients
- ✔ Efficiency have been proven on variety of crops and under different growth conditions

Thank You

Join-up our knowledge community
www.haifa-group.com/community

