



Multi-K[®]

**Potassium Nitrate Products
For Healthy Crops**





Contents

- ♥ Potassium in the plant
- ♥ Multi-K[®] and its advantages
- ♥ Nutrigation[™] with Multi-K[®]
- ♥ Foliar nutrition with Haifa Bonus
- ♥ Multi-K[®] properties
- ♥ Multi-K[®] products
- ♥ Potassium in the soil



Pioneering Solutions

Haifa's Specialty Fertilizer Promise Farmers

**Enhanced
Plant
Development**

**Maximum
Nutrient
Efficiency**

**Minimal
Environmental
Impact**





Potassium in the Plant



Plant Nutrients

Macro nutrients:

N (Nitrogen), **P** (Phosphorus), **K** (Potassium)

Secondary nutrients:

Ca (Calcium), **Mg** (Magnesium), **S** (Sulfur)

Micro nutrients:

Fe (Iron), **Cu** (Copper), **Zn** (Zinc), **B** (Boron),
Mn (Manganese), **Mo** (Molybdenum), **Cl** (Chloride)

Potassium (K) in the plant



- ❖ Necessary for formation of sugars and starch
- ❖ Activator of enzymatic reaction
- ❖ Maintains turgor
- ❖ Regulates opening of leaf stomata
- ❖ Build cell walls

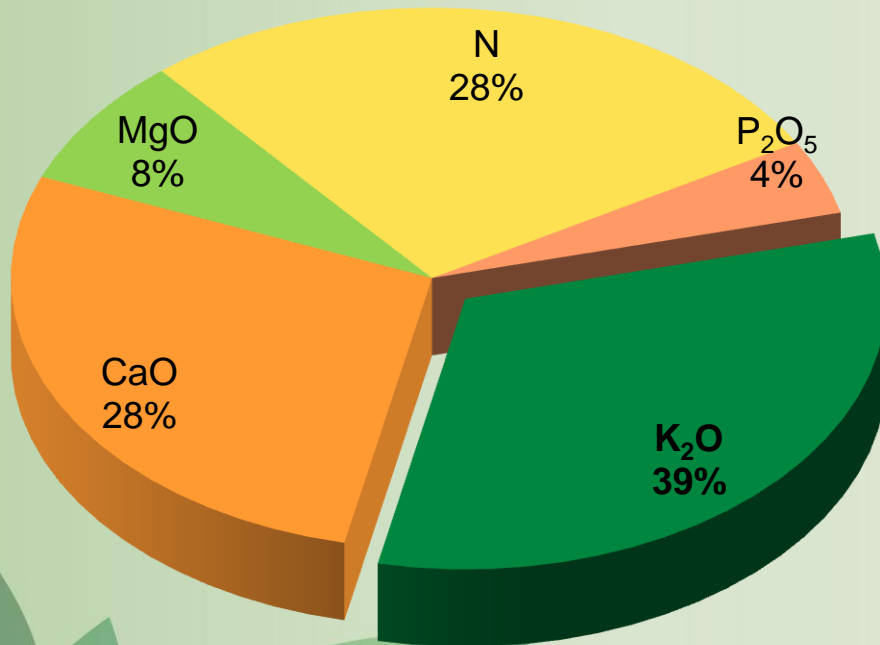
Potassium (K) in the plant



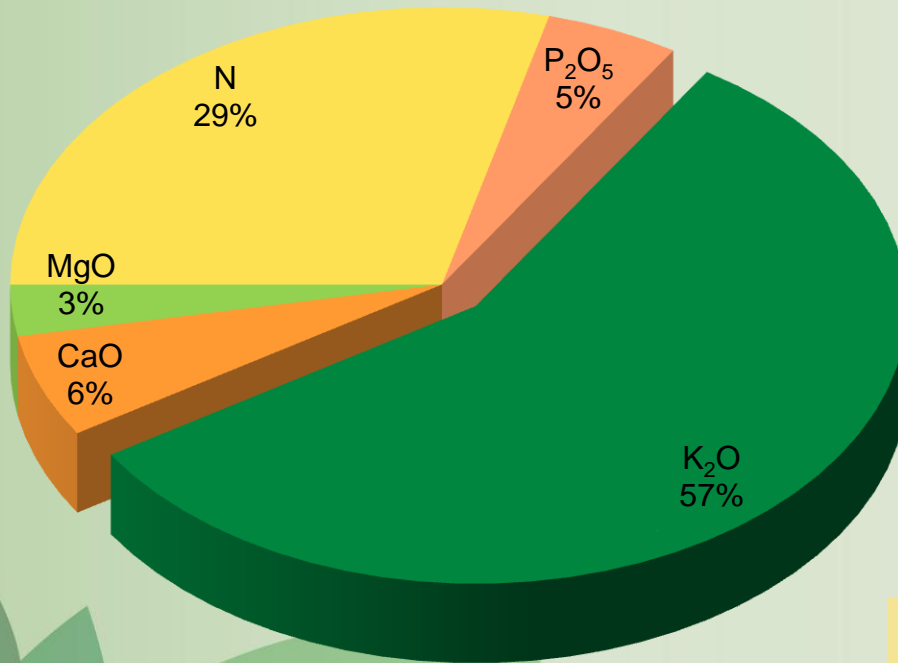
Due to its roles in many plant systems, potassium improves plant durability and improves yield quality:

- ❖ Improved drought resistance
- ❖ Increased winter hardiness
- ❖ Better disease resistance
- ❖ Improved yield quality
- ❖ Longer storage life

Potassium composition of tomato plant



Potassium composition of tomato fruit

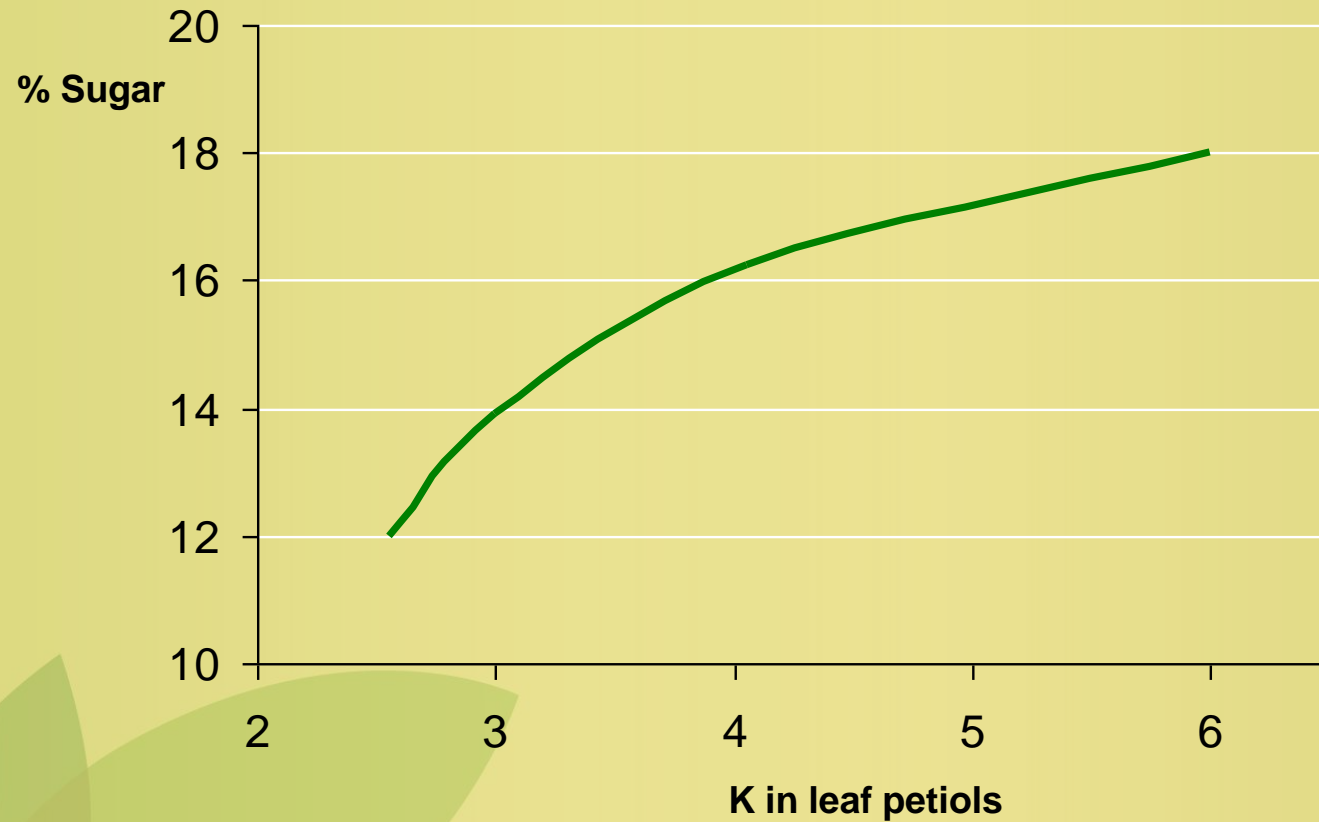


The tomato fruit contains:
up to 82% of total plant K
up to 63% of total plant P

(Source: Atherton and Rudich, 1986)



Relation between K in petiols and sugar content in Sugar-Beet



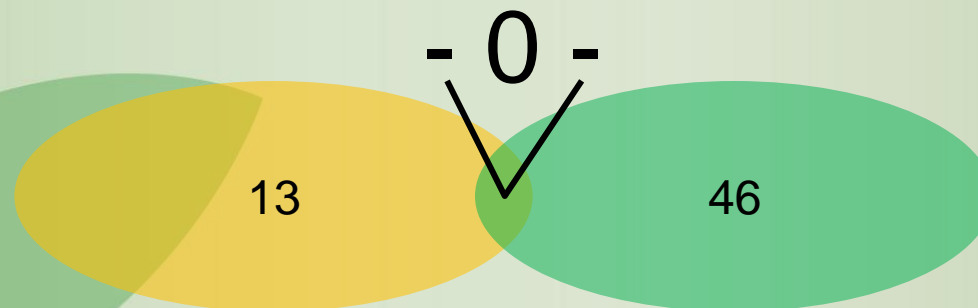
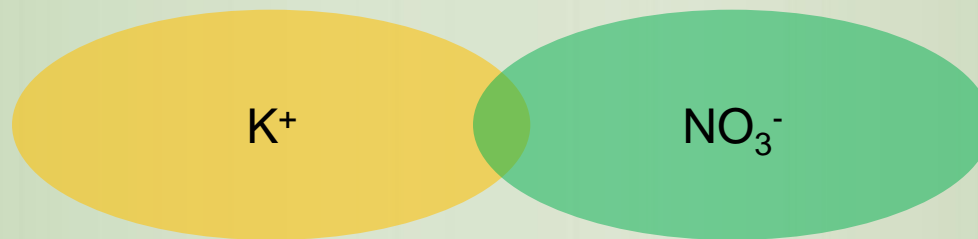
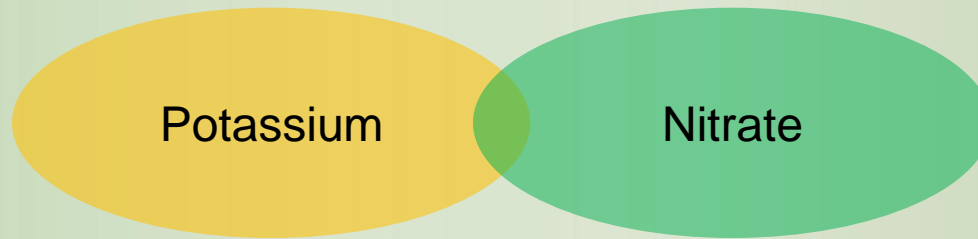


What is Multi-K[®]?

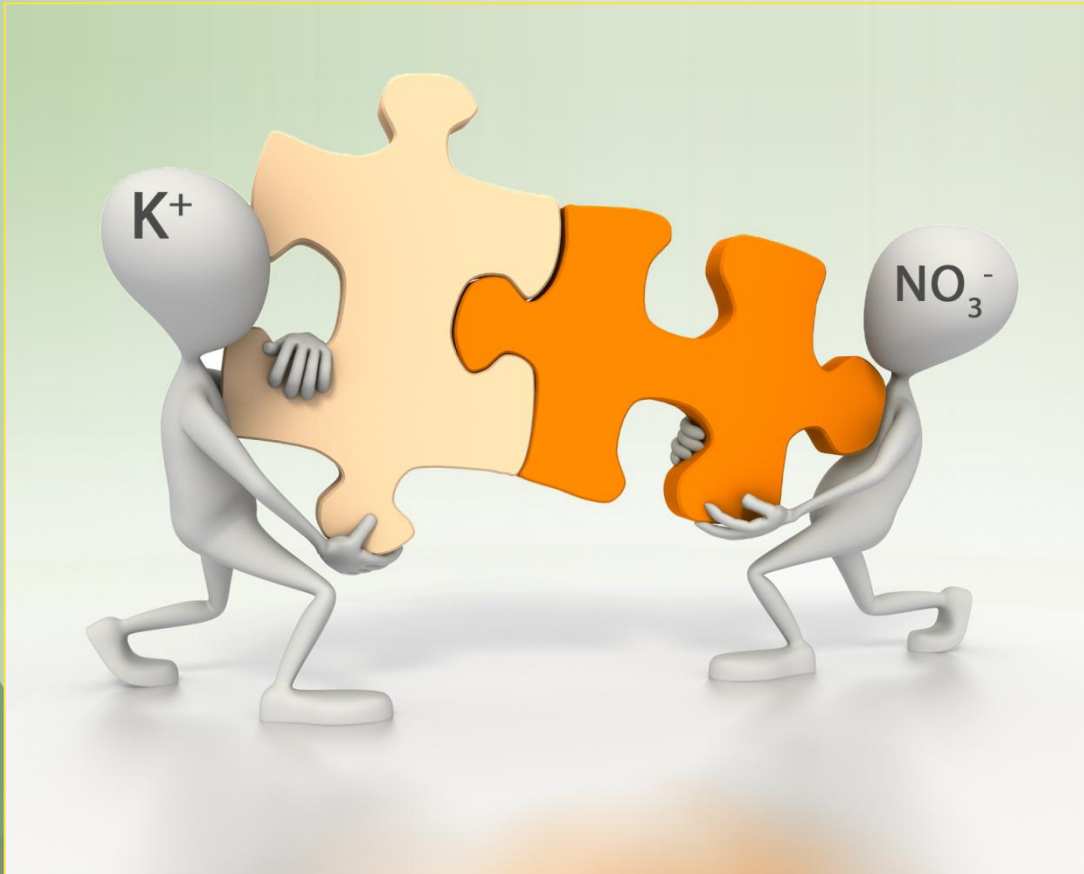




What is Multi-K[®] ?



Advantages: synergistic effect



Nitrate facilitates uptake and improves absorption potassium by the plant.

Advantages: efficient N source



All the nitrogen in Multi-K[®] is the form of Nitrate (NO_3^-)





Advantages: pure plant nutrients

Multi-K[®] consists of plant nutrients only:

N	P ₂ O ₅	K ₂ O
13%	0%	46%

13% N = 62 % NO₃⁻

46% K₂O = 38 % K

Total: 100 % KNO₃



Advantages: free of harmful elements

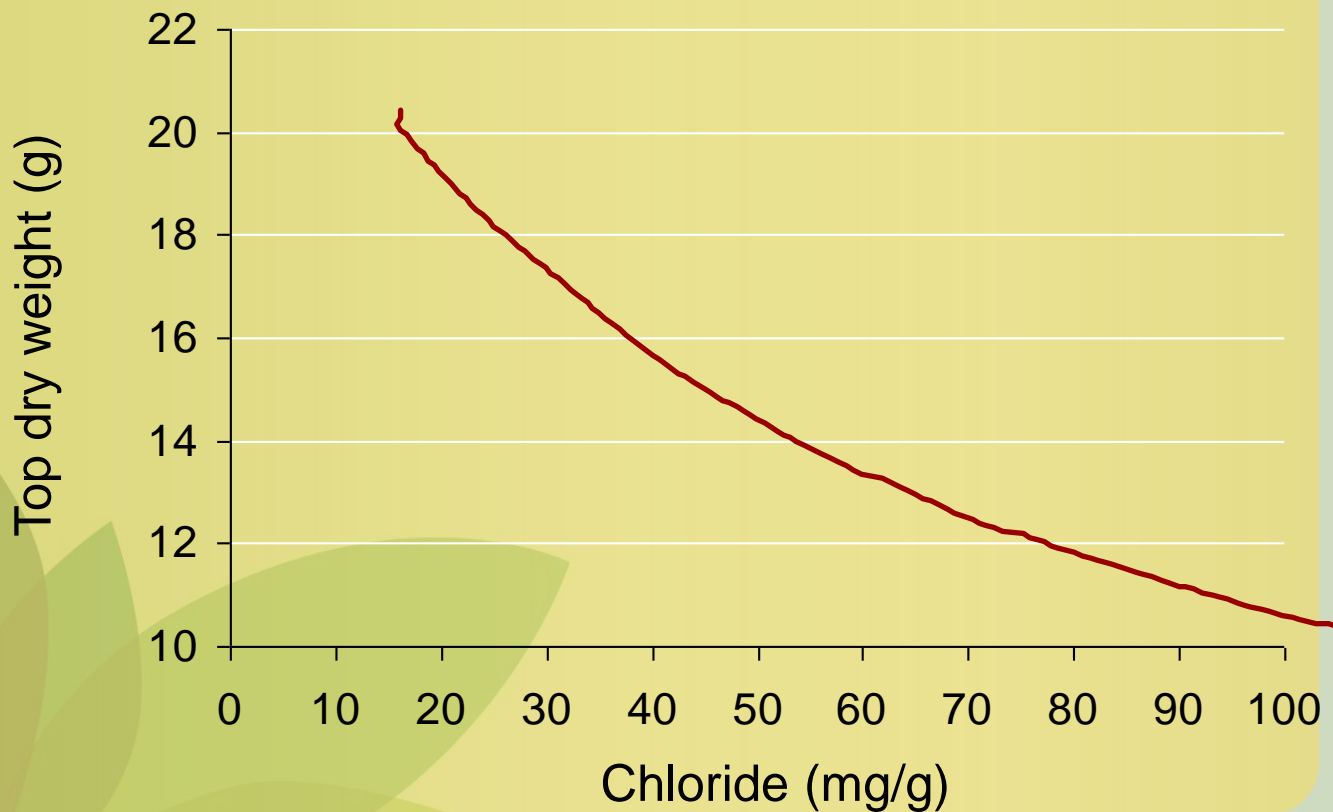
Multi-K[®] is free of chloride, sodium and any other harmful elements for the plant



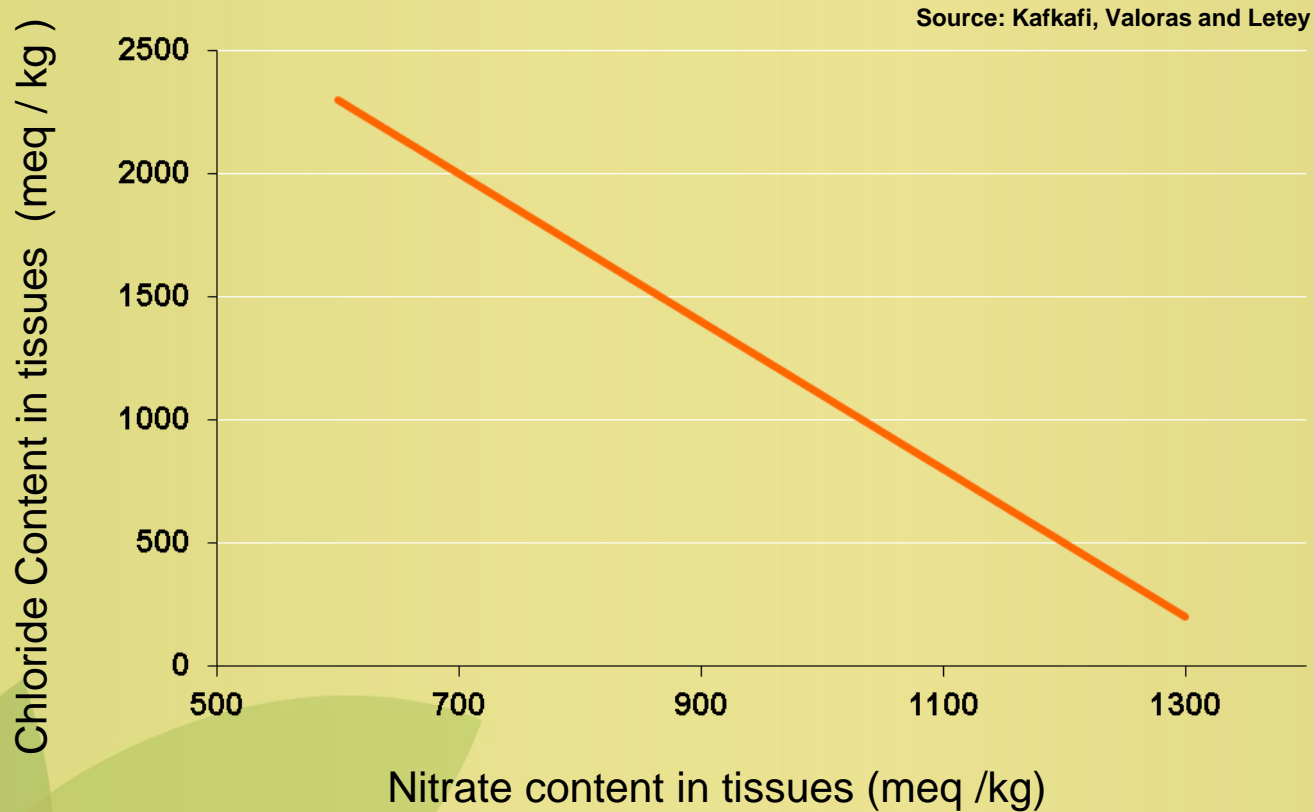
Chloride: the hidden enemy



The effect of chloride concentration in plant tissue on top dry weight:



Multi-K[®] helps reversing the adverse effects of chloride



Application of nitrate reverses the process of chloride accumulation in the plant tissues.



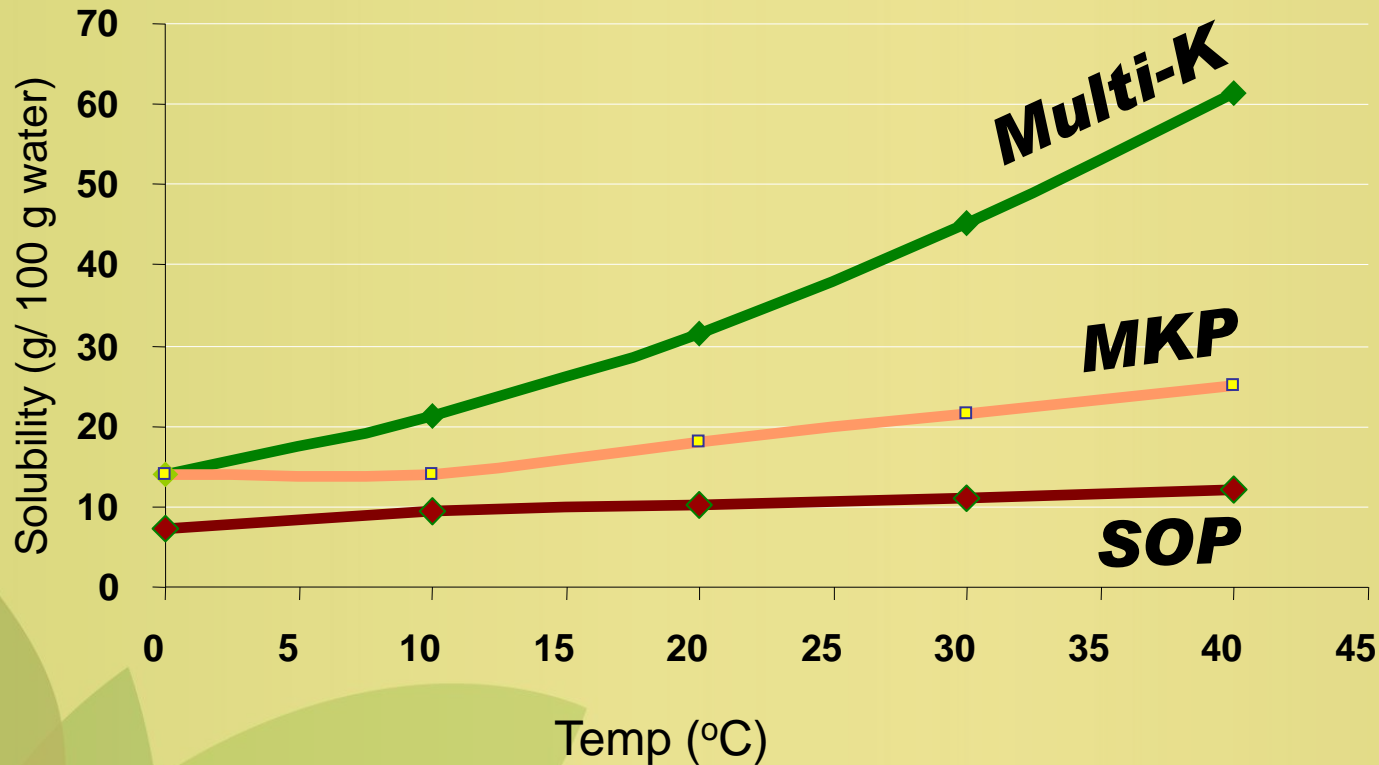
Advantages: High solubility

Multi-K is fully soluble in water,
safe for
Nutrigration through all irrigation systems.





Advantages: High solubility



Multi-K[®] is more soluble than other chloride-free potassium fertilizers



Advantages: application methods

Multi-K[®] products suit highly-efficient application methods:

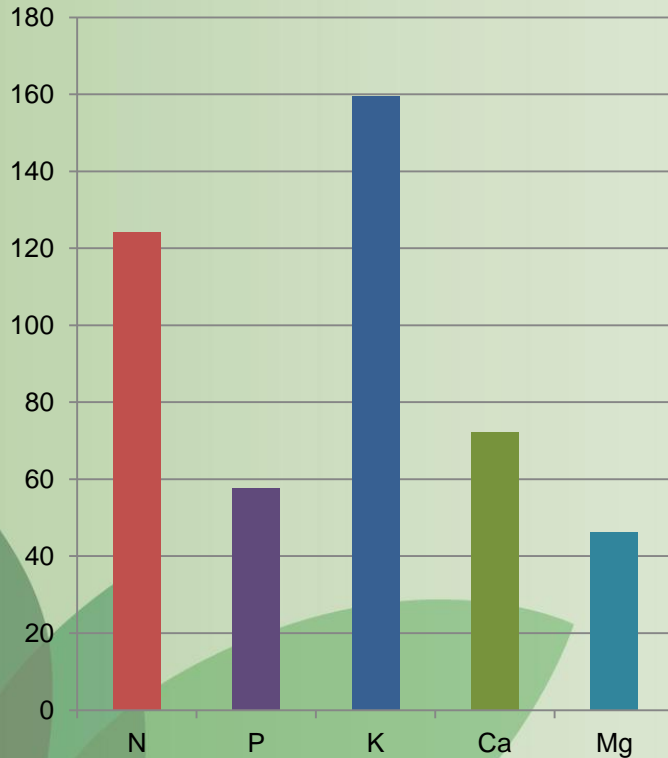
- ▼ **Nutrigation™**
- ▼ **Foliar application**
- ▼ **Side-dressing**

These methods enable matching nutrient supply to plant dynamic needs

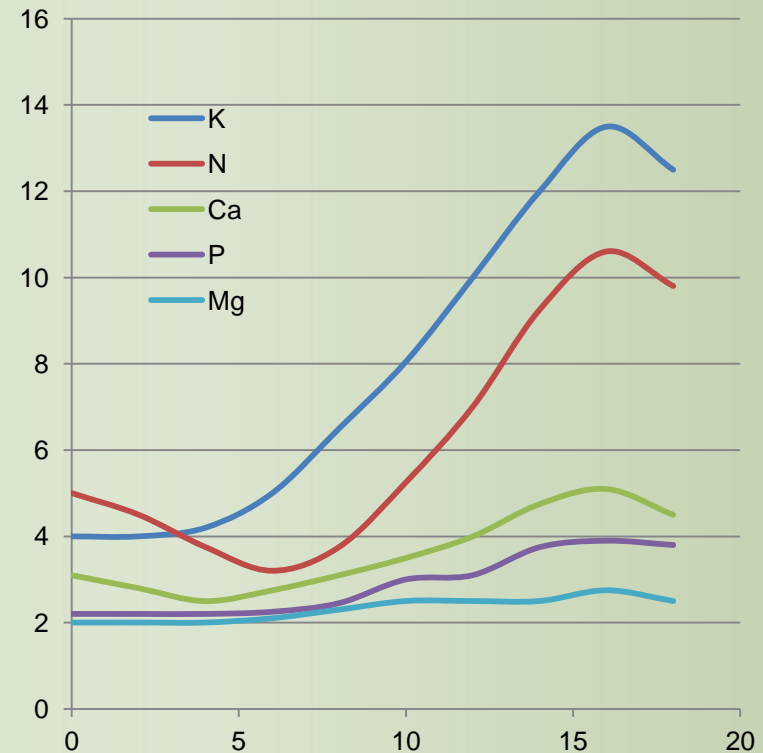


Dynamics of Nutrient Uptake

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™ with Multi-K®



Nutrigation™ with Multi-K® in tomatoes



	N	P ₂ O ₅	K ₂ O
Crop requirements kg/ha	300	60	550
Correction factor soil application	1.2-1.25	1.9-2.2	1.4-1.6
Correction factor Nutrigation	1.1-1.2	1.6-1.9	1.2-1.4
Corrected requirements	330	100	650
Nutrient level in the soil		20 ppm	150 kg/ha
Balance to apply	330	100	500



Nutrigation™ with Multi-K® in tomatoes

	N	P ₂ O ₅	K ₂ O
Required rate kg/ha:	330	100	500

Base-dressing	%	30%	50%	30%
	kg/ha	100	50	150

Nutrigation	%	70%	50%	70%
	kg/ha	230	50	350

Nutrigation™ with Multi-K® in tomatoes



A. Base-Dressing	N	P ₂ O ₅	K ₂ O
Application rate kg/ha:	100	50	150
Source	AS	TSP	SOP
Composition	21-0-0	0-46-0	0-0-50
kg/ha	480	110	300

Nutrigation™ with Multi-K® in tomatoes



B. Nutrigation

	N	P ₂ O ₅	K ₂ O
%	70%	50%	70%
kg/ha	230	50	350

Growth phase	N:P ₂ O ₅ :K ₂ O ratio	kg/ha/day			days	Total		
		N	P ₂ O ₅	K ₂ O		N	P ₂ O ₅	K ₂ O
Planting to flowering	1:1:1	1.0	1.0	1.0	30	30	30	30
Flowering to fruit-set	2:0.4:3	4.0	0.8	6.0	25	100	20	150
Fruit-set to ripening	1:0:2	3.0	0	6.0	20	60	0	120
Fruit ripening to harvest	2:0:3	1.3	0	1.7	30	40	0	50
Total						230	50	350

Nutrigation™ with Multi-K® in tomatoes



Detailed Nutrigation program

Growth phase	Fertilizers	Ratio			kg/ha/day	kg/ha/day		
		N	P ₂ O ₅	K ₂ O		N	P ₂ O ₅	K ₂ O
Planting to flowering	Multi-K®	30	0	46	2.2	0.28	---	1.0
	Haifa MAP	12	61	0	1.65	0.18	1.0	---
	A.N.	34	0	0	1.60	0.54	---	---
	Total	1	1	1		1.0	1.0	1.0
Flowering to fruit-set	Multi-K®	12	0	46	13.0	1.7	---	6.0
	Haifa MAP	12	61	0	1.3	0.15	0.8	---
	A.N.	34	0	0	6.3	2.15	---	---
	Total	2	0.4	3		4.0	0.8	6.0

Nutrigation™ with Multi-K® in tomatoes



Detailed Nutrigation program

Growth phase	Fertilizers	Ratio			kg/ha/day	kg/ha/day		
		N	P ₂ O ₅	K ₂ O		N	P ₂ O ₅	K ₂ O
Fruit-set to ripening	Multi-K®	13	0	46	13.0	1.7	---	6.0
	A.N	34	0	0	3.8	1.3	---	---
	Urea	46	0	0	2.8	1.3	---	---
	Total	1	0	2		3.0		6.0
Fruit ripening to harvest	Multi-K®	13	0	46	3.7	0.5	---	1.7
	A.N	34	0	0	2.4	0.8	---	---
	Urea	46	0	0	1.8	0.8	---	---
	Total	2	0	3		1.3		1.7



Foliar Nutrition with Haifa Bonus





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 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.



Multi-K[®] Properties





Water solubility

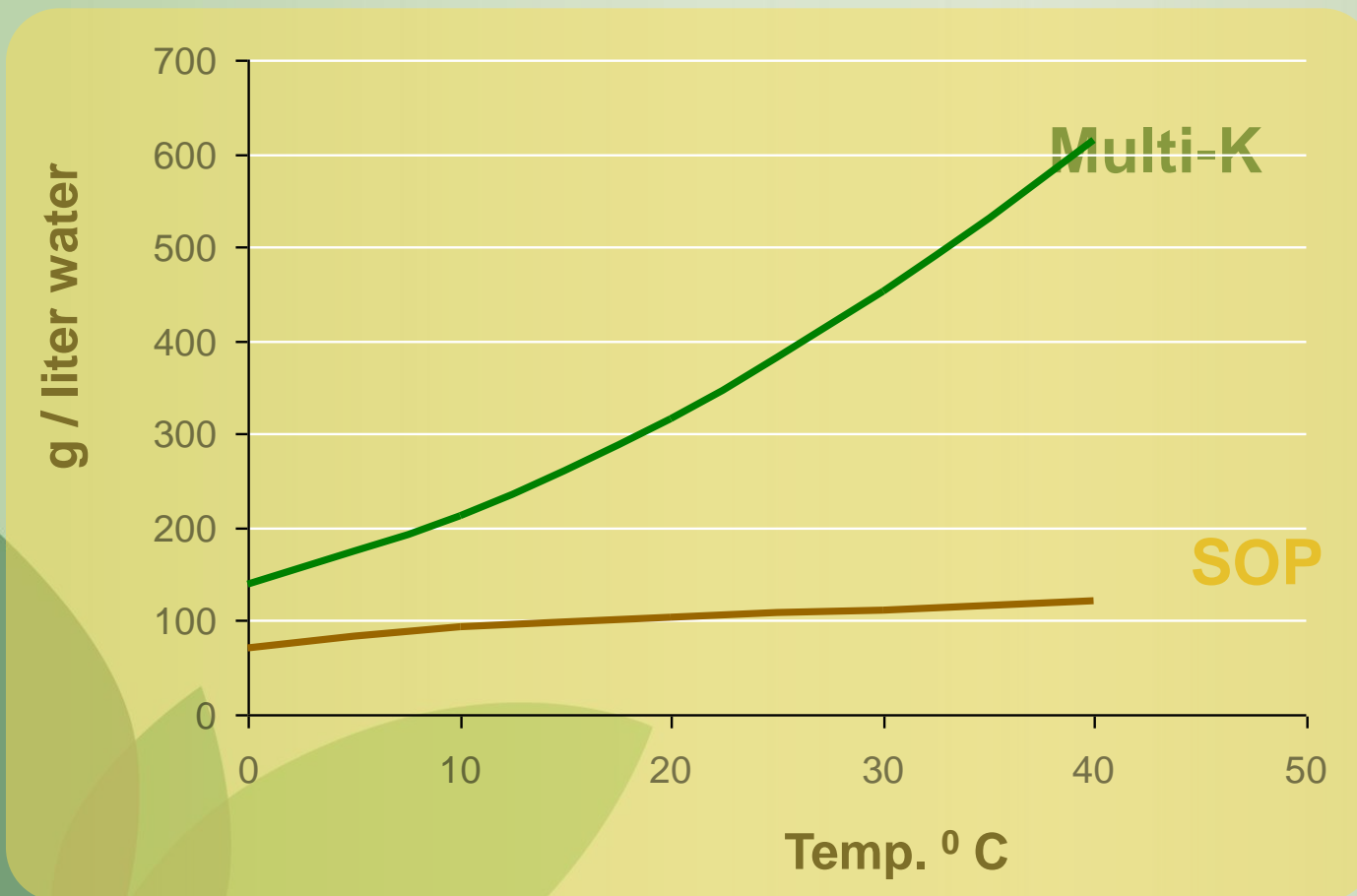
Water temperature (°C)	g Multi-K [®] / liter water
0	139
10	212
20	316
30	453
40	613



pH and EC

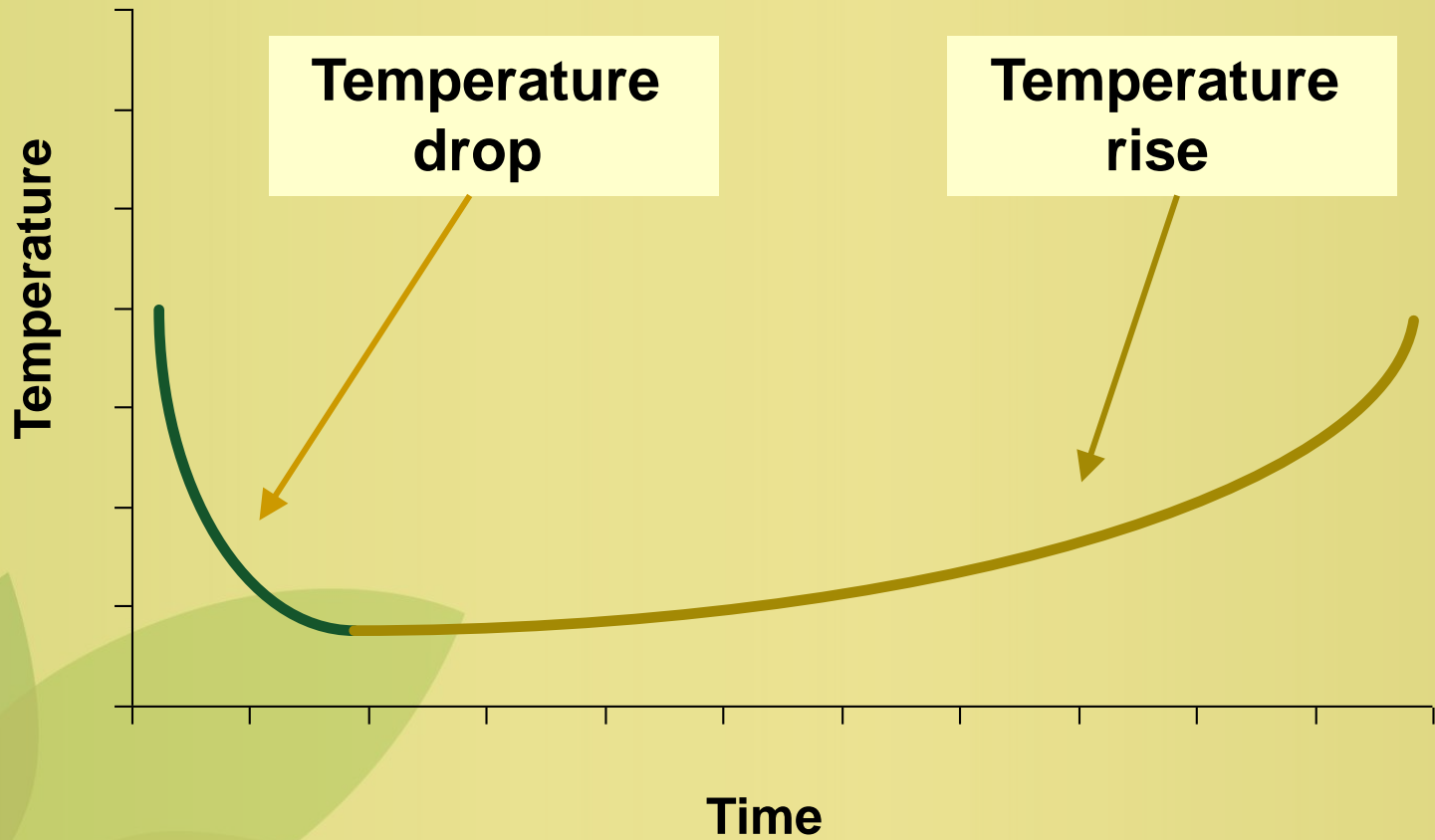
Concentration (%)	pH	EC (mS/cm)
0.05	6.5	0.68
0.1	8.7	1.30
0.15	9.1	1.96
0.2	9.3	2.60
0.3	9.6	3.80
1.0	9.9	11.40

The effect of water temperature on solubility





Dissolution in water: the endothermic effect





Multi-K[®] Products





Multi-K[®] potassium nitrate

Complete range of potassium nitrate products

- ♥ Crystalline Products (Nutrigration, foliar application)
- ♥ Prills & Granules (side-dressing)
- ♥ Special Grades (greenhouses)
- ♥ Enriched formulas (+ P, Mg, B, Zn, S, Micronutrients)



Multi-K[®] potassium nitrate

Multi-K[®] Classic

Multi-K[®] Zn

Multi-K[®] GG

Multi-K[®] ME

Multi-K[®] pHast

Multi-K[®] Prills

Multi-K[®] TOP

Multi-npK[®] Prills

Multi-npK[®]

Multi-K[®] Mg Prills

Multi-K[®] Mg

Haifa Bonus

Multi-K Classic

Crystalline potassium nitrate



N total	13.4%
N-NO ₃	13.4%
K ₂ O	46.0%
K	38.1%
Insoluble matter	350 ppm
Bulk density	1.0 g/cm ³

Applications

- ✔ Nutrigation and foliar feeding of all crops
- ✔ Preparation of fertilizer blends
- ✔ Production of liquid fertilizers

Packaging

25, 50, 500 and 1000kg bags



Multi-K GG

Greenhouse-Grade potassium nitrate



N total	13.5%
N-NO ₃	13.5%
K ₂ O	46.2%
K	38.4%
Insoluble matter	350 ppm
Bulk density	1.1 g/cm ³

Applications

- ♥ Nutrigation and foliar feeding of all crops
- ♥ Preparation of fertilizer blends
- ♥ Production of liquid fertilizers

Packaging

25, 50, 500 and 1000kg bags



Multi-K pHast

Low-pH potassium nitrate



N total	13.5%
N-NO ₃	13.5%
K ₂ O	46.2%
K	38.4%
pH (10% soln.)	4.0
Insoluble matter	150 ppm
Bulk density	1.0 g/cm ³

Applications

♥ Nutrigation and foliar feeding

Packaging

25, 50, 500 and 1000kg bags



Multi-K TOP

Top-Grade potassium nitrate



N total	13.8%
N-NO ₃	13.8%
K ₂ O	46.5%
K	38.6%
pH (10% soln.)	6.0-8.5
Insoluble matter	180 ppm
Bulk density	1.0 g/cm ³

Applications

- ♥ Hydroponics
- ♥ Nutrification of top-quality crops
- ♥ Preparation of fertilizer blends and nutrient solutions

Packaging

25, 500 and 1000kg bags



Multi-npK

Potassium nitrate enriched with phosphorus



Available formulae

- ♥ 13-5-42
- ♥ 13-3-43
- ♥ 13-2-44

Applications

Nutrigation and foliar feeding of all crops

Packaging

25, 500 and 1000kg bags



Multi-K Mg

Potassium nitrate enriched with magnesium



Available formulae

- ♥ 12-0-43+2MgO
- ♥ 11-0-40+4MgO
- ♥ 12-2-43+1MgO
- ♥ 12-2-42+2MgO+0.5Mn
- ♥ 12-0-42+2MgO+0.2B

Applications

- ♥ Nutrigation and foliar feeding of all crops
- ♥ Favorable source of potassium for magnesium-consuming crops (e.g. potato, tobacco, bulbs)

Packaging

25, 50, 500 and 1000kg bags



Multi-K Zn

Potassium nitrate enriched with zinc



Available formulae

- ♥ 11-0-40+4Zn
- ♥ 12-0-43+2Zn

Applications

- ♥ Nutrigation and foliar feeding of all crops
- ♥ Prevention and curing of zinc deficiencies (e.g. in citrus and pecan)

Packaging

25, 500 and 1000kg bags



Multi-K ME

Potassium nitrate enriched with magnesium and micro-nutrients



N total	12.0%	Micro-Nutrients	
N-NO ₃	12.0%	Fe*	1000 ppm
K ₂ O	43.0%	B	200 ppm
K	35.7%	Zn*	140 ppm
MgO	1.0%	Mn*	500 ppm
pH (10% soln.)	4.5-6.5	Mo	70 ppm
Insoluble matter	500 ppm	Cu*	110 ppm
		* EDTA chelates	

Applications

Nutrigation and foliar feeding of all crops

Packaging

25 kg bags



Multi-K Prills

Potassium nitrate prills



N total	13.2%
N-NO ₃	13.2%
K ₂ O	46.0%
K	38.1%
Bulk density	1.2 g/cm ³

Applications

- ♥ Base-dressing and side-dressing of all crops
- ♥ Bulk-blending- production of granular NPK fertilizers

Packaging

25, 50, 500 and 1000kg bags



Multi-npK prills

Potassium nitrate enriched with phosphorus



Available formulae

13-3-43

13-2-44

Applications

- ♥ Base-dressing and side-dressing of all crops
- ♥ Bulk-blending- production of granular NPK fertilizers

Packaging

25, 50, 500 and 1000kg bags



Multi-K Mg prills

Potassium nitrate enriched with magnesium



Available formulae

- ♥ 12-0-42+2MgO
- ♥ 11-0-39+4MgO

Applications

- ♥ Base-dressing and side-dressing of all crops
- ♥ Favorable source of potassium for magnesium-consuming crops (e.g. potato, tobacco, bulbs)

Packaging

25, 50, 500 and 1000kg bags





Haifa Bonus

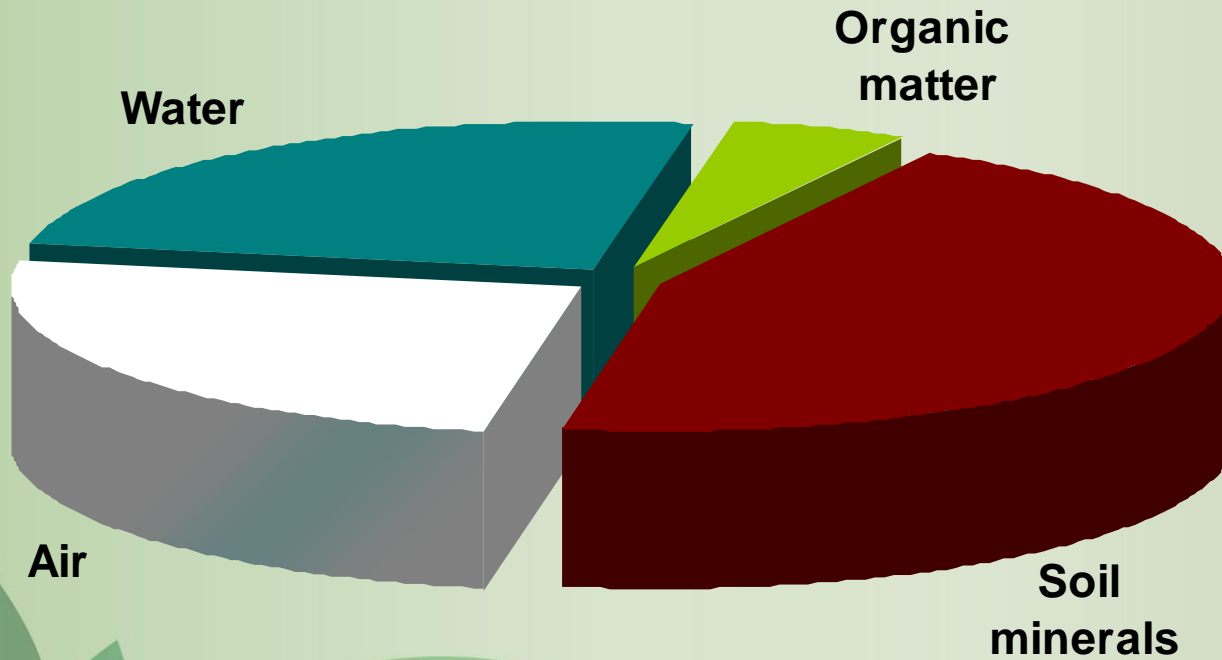
- High-K foliar formulas
- Specially designed to allow for concentrated sprays
- Based on Multi-K[®] potassium nitrate
- Enriched with phosphorus
 - To enhance nutritional value
 - To keep pH at the optimal level for foliar absorption
 - For improved compatibility with pesticides
- Contains special adjuvant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



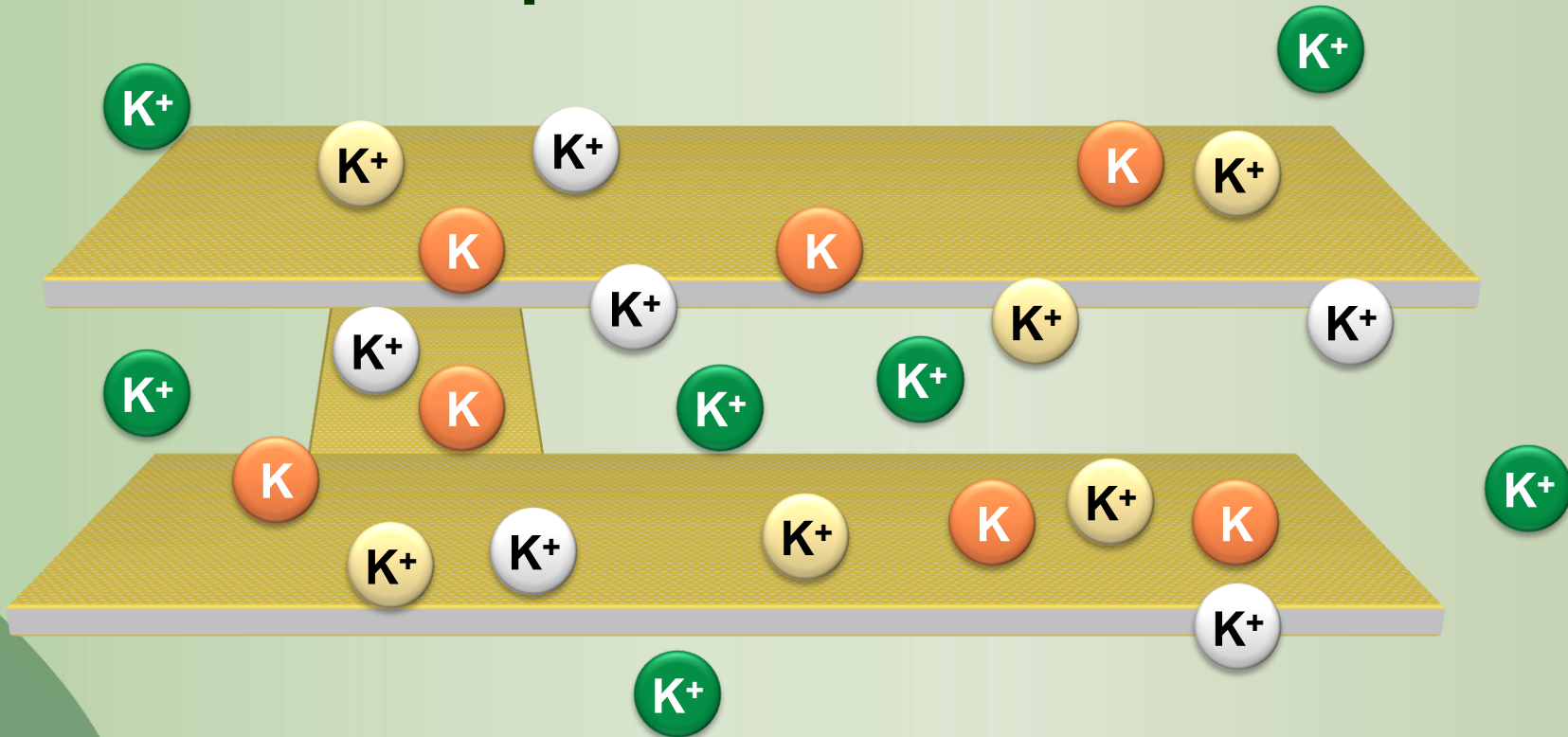


Potassium in the Soil

The 4 principal components of soil



Forms of soil potassium



Negatively-charged soil particle



Mineral K – unavailable



Fixed (non-exchangeable) K – unavailable

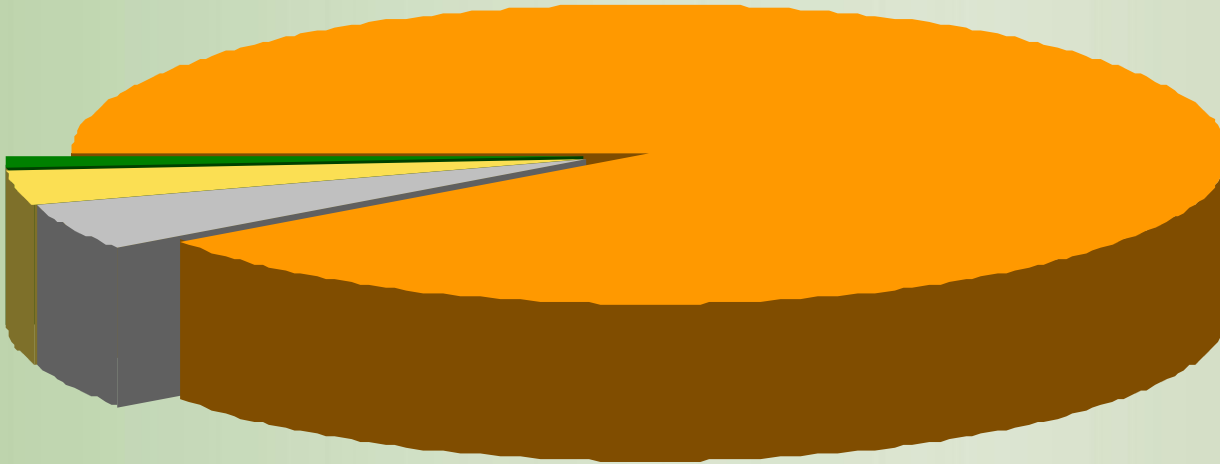


Exchangeable K – absorbed to the surface of soil particles



K in the soil solution
Readily available for plant uptake

Typical distribution of K forms in the soil



Mineral K – unavailable



Exchangeable K – absorbed to the surface of soil particles



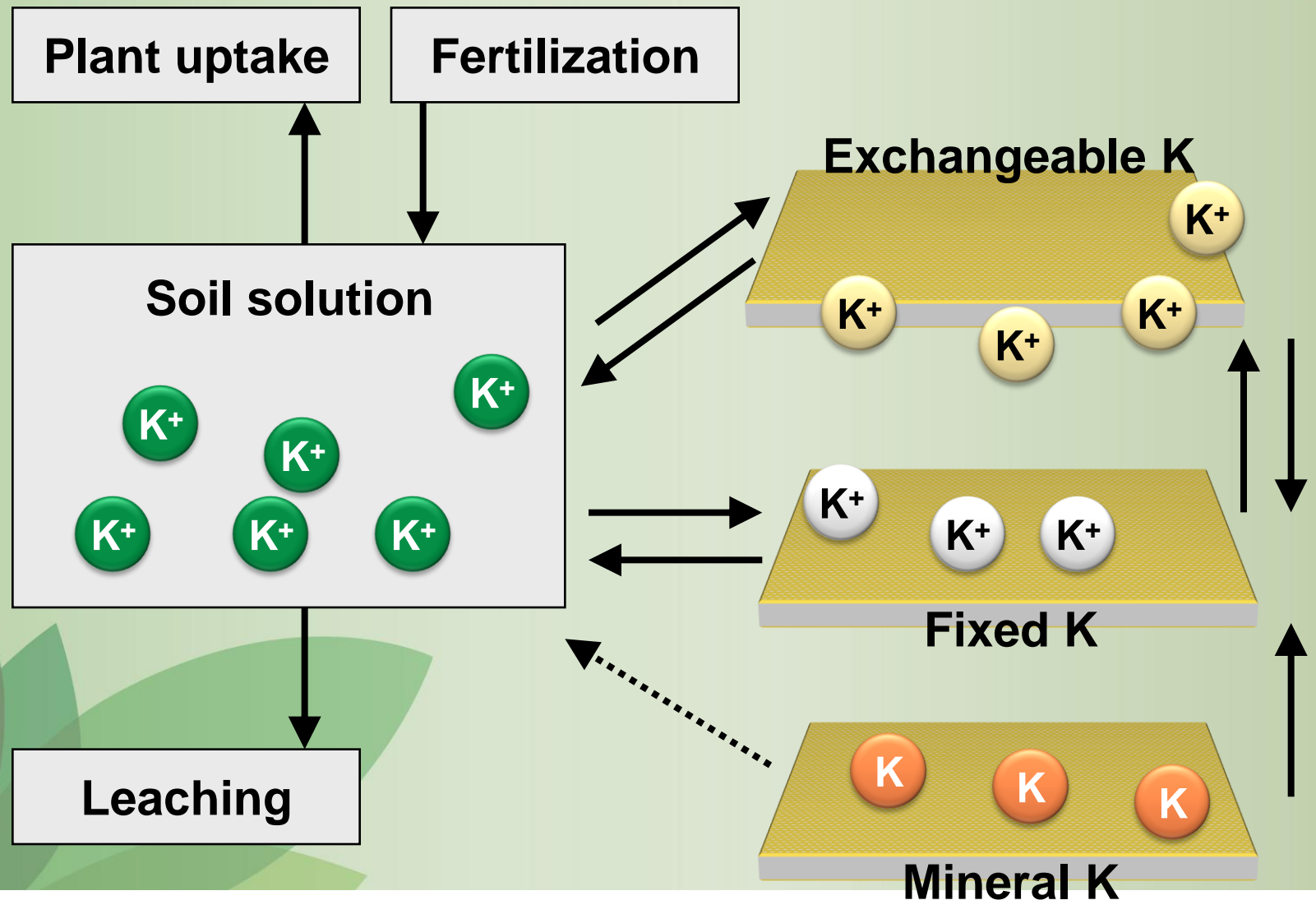
Fixed (non-exchangeable) K – unavailable



K in the soil solution
Readily available for plant uptake

90-95% of soil potassium is unavailable for plant uptake

Dynamics of soil potassium





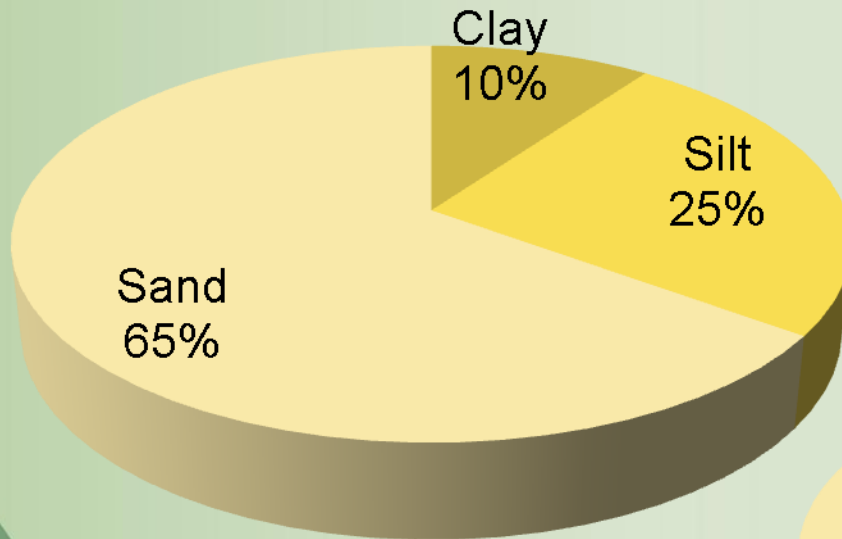
Relative size of soil particles



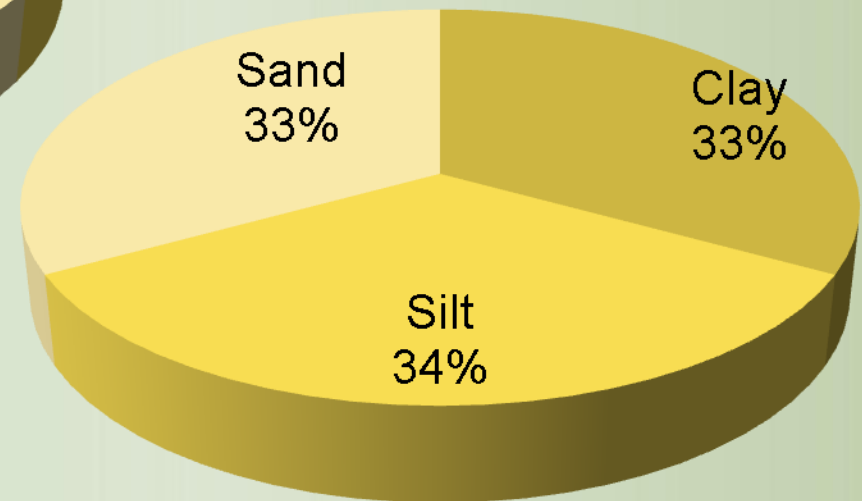


Composition of soil mineral matter

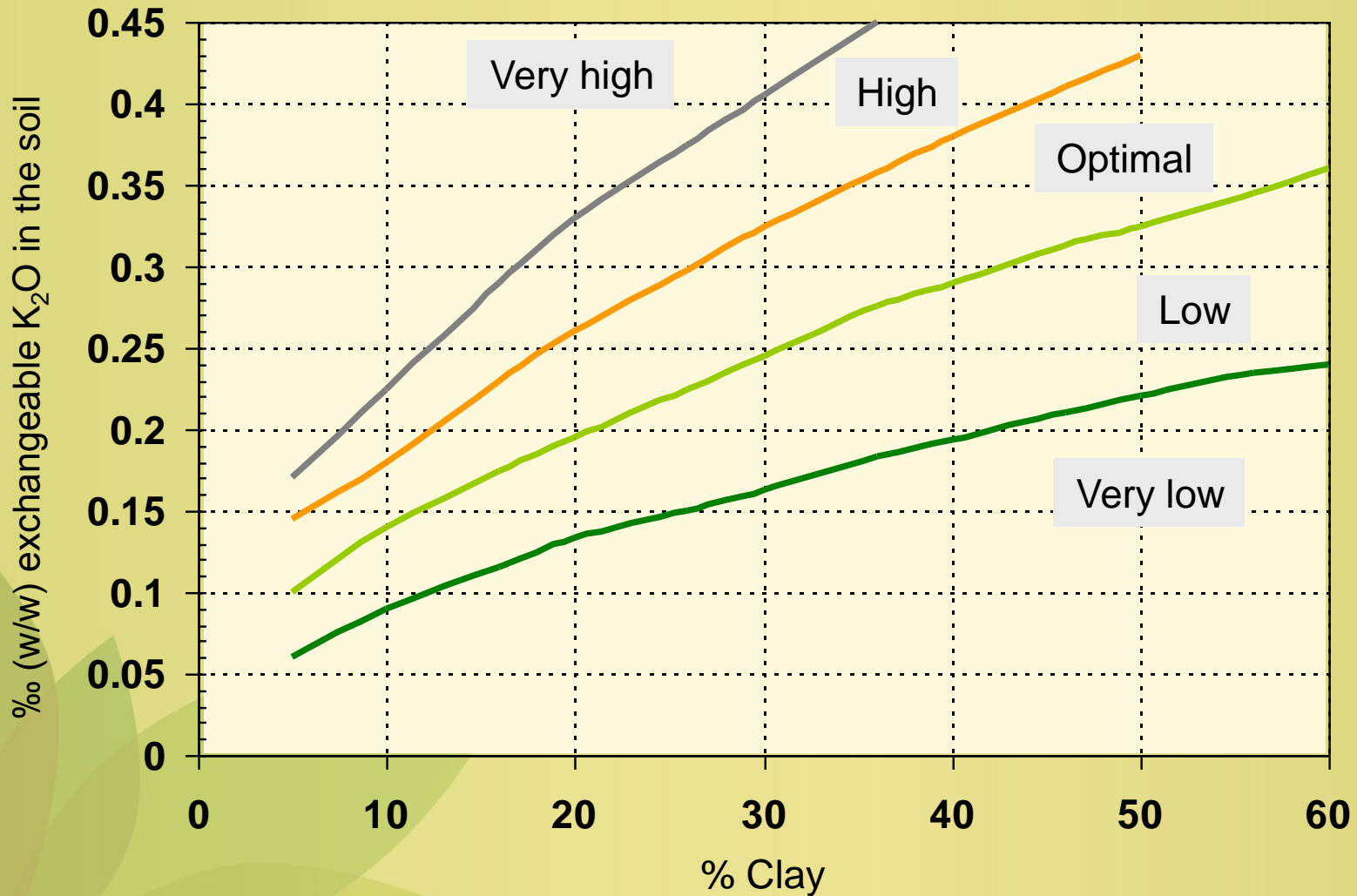
Sandy loam



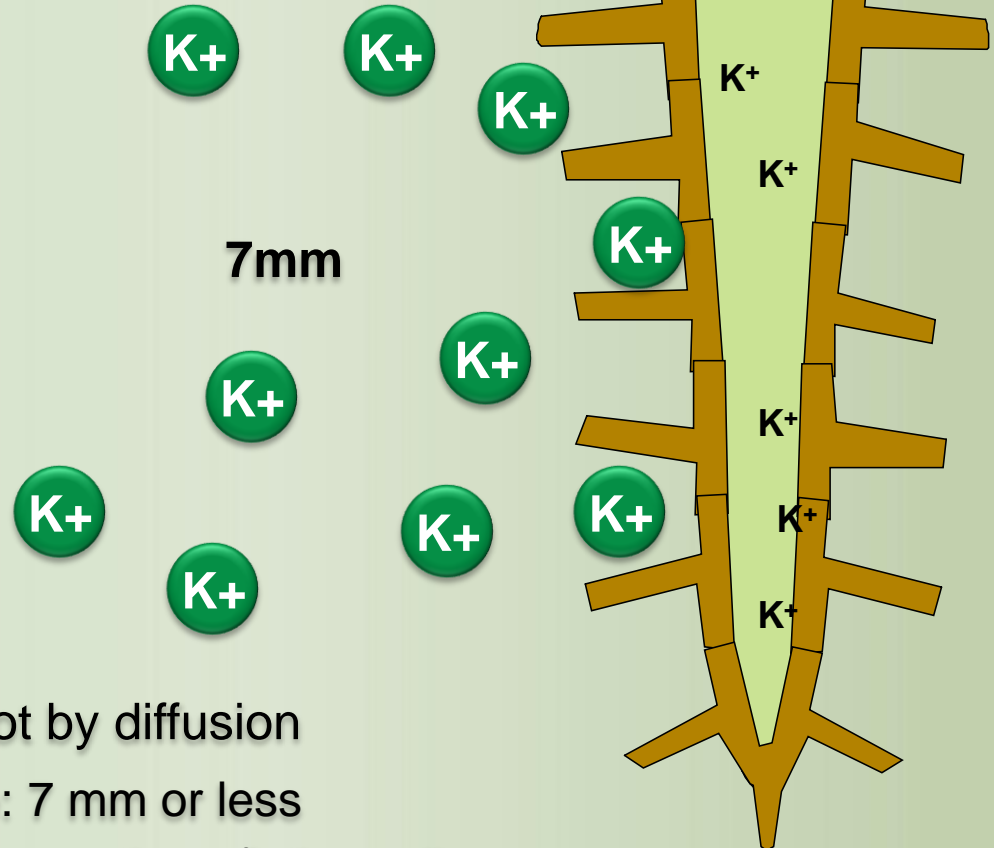
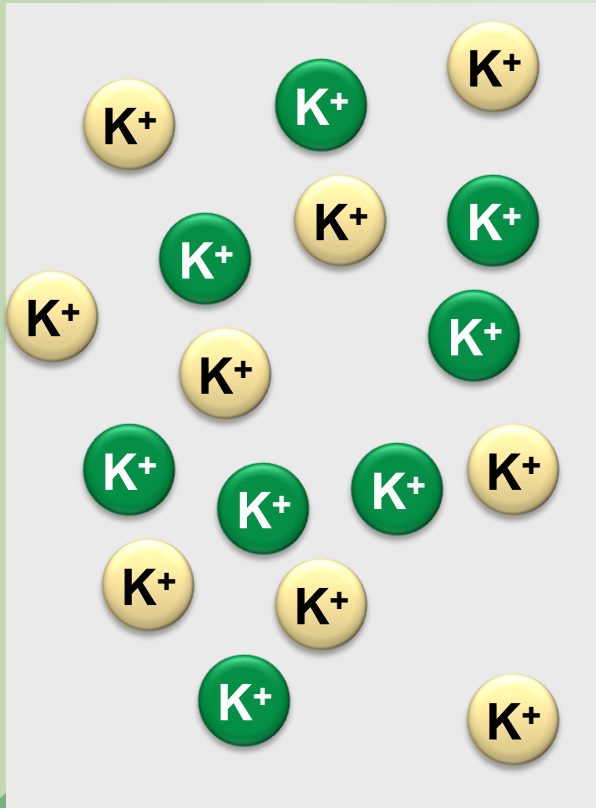
Loam



Potassium availability as a function of content and conc. of exchangeable potassium



How potassium moves from soil to root



Most potassium reaches root by diffusion
K⁺ travels only short distance: 7 mm or less
Roots contact only small proportion of the soil
K⁺ supply near root may be depleted even in high K soil



Pioneering Solutions

Haifa's Specialty Fertilizer Promise Farmers

**Enhanced
Plant
Development**

**Maximum
Nutrient
Efficiency**

**Minimal
Environmental
Impact**





Summary

Multi-K[®] is the ideal source of potassium (K) for plants:

- ✦ Enriches plant nutrition with nitrate-N
- ✦ Contains plant nutrients only
- ✦ Free of sodium and chloride
- ✦ Suitable for highly-efficient applications
 - ✦ Nutrigation™
 - ✦ Foliar nutrition (recommended to use Haifa Bonus)
 - ✦ Side-dressing
- ✦ Wide range of formulae to suit all crops and growth environments.

Thank You

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

