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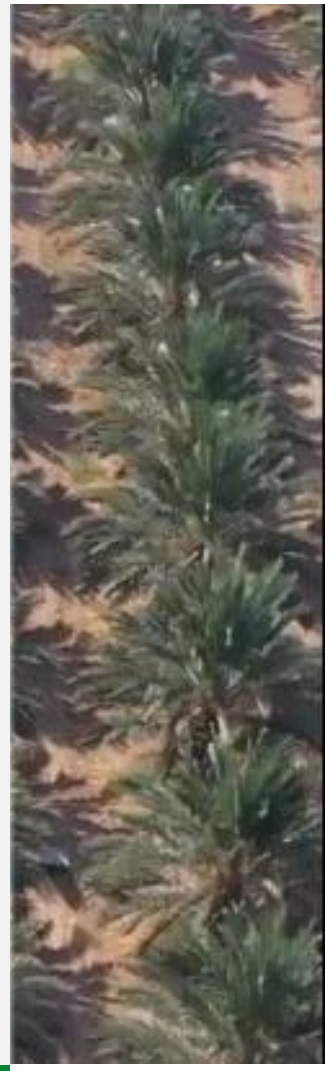
The effect of calcium on the phenomenon of peeling (Skin separation) In Majhool dates

Muayyad Smadi

Amman

14th Nov. 2023



01. Introduction : Plant nutrition

02. Types of Ca in the Plant

03. FUNCTIONS of Ca

04. Ca & Skin Separation in Majhool Dates

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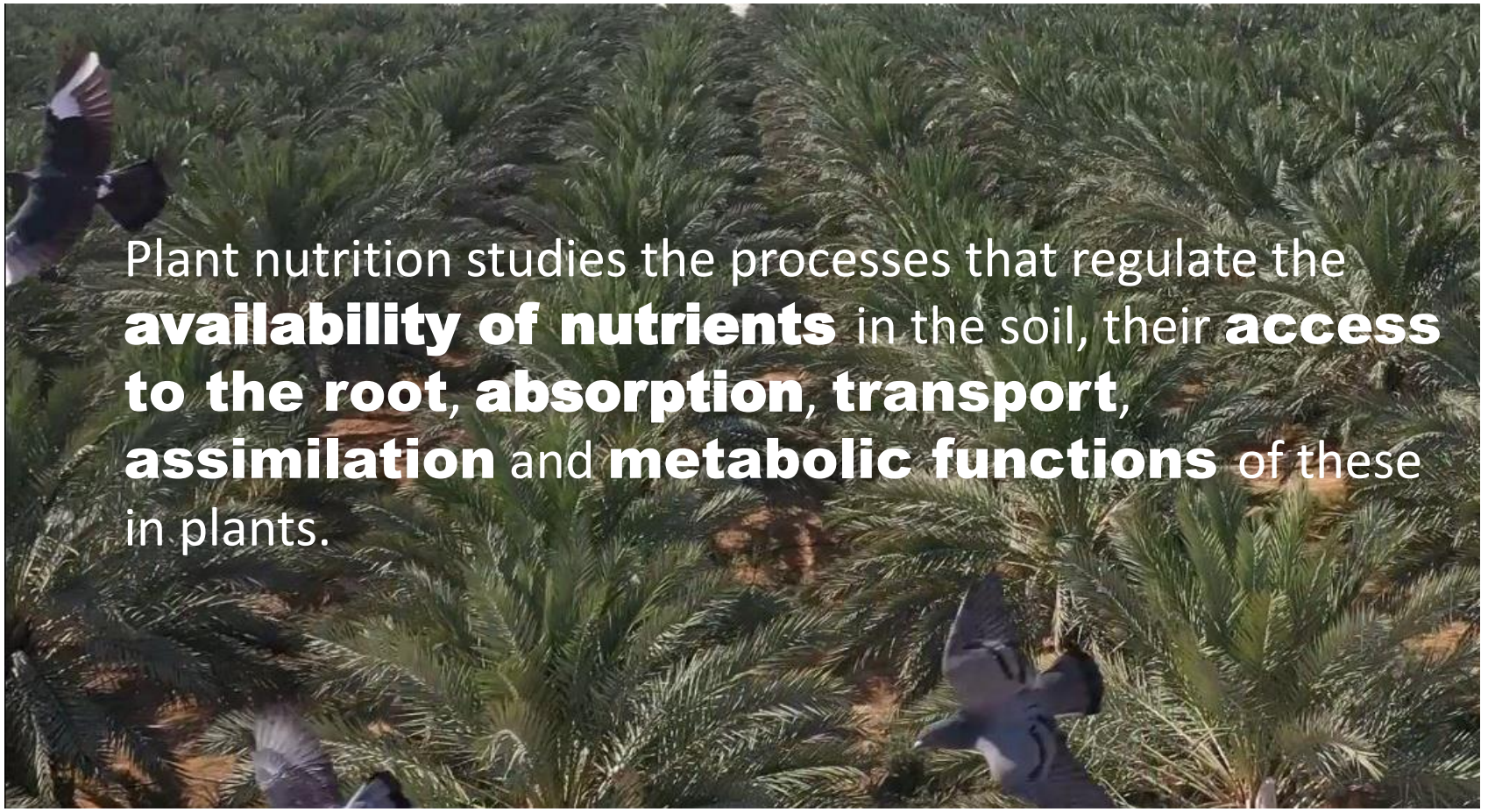
KHALIFA INTERNATIONAL AWARD FOR DATE PALM AND AGRICULTURAL INNOVATION

JORDAN INTERNATIONAL 5th Date Palm Festival

Passion and **Technology**

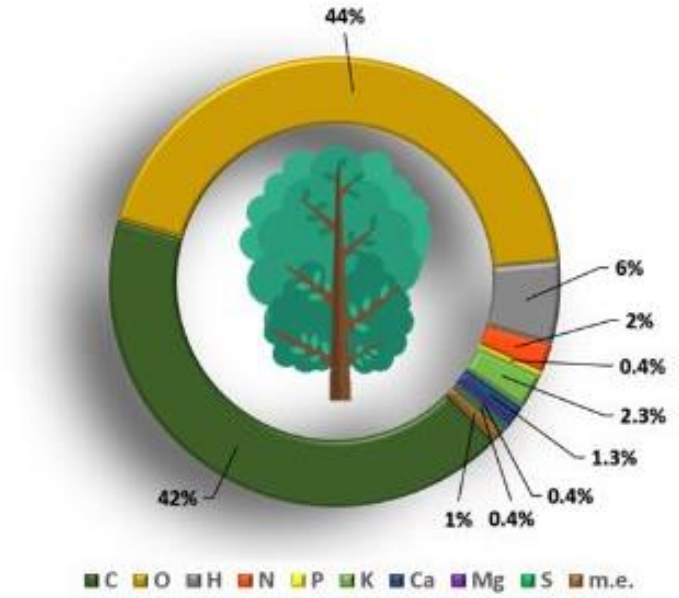
Plant Nutrition

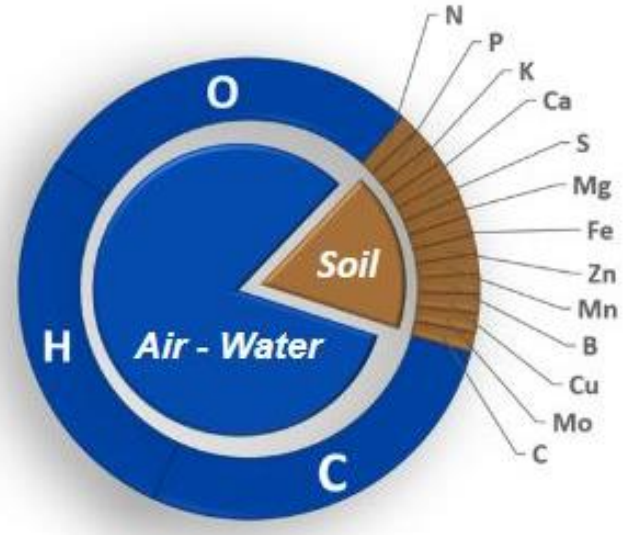


Plant Composition

Dry matter is plant tissue to which 100% of water has been extracted (plant tissue without water) .

92% of total dry matter is C, H y O, 8% is N, P, K, Ca, S, Mg, Fe, Zn, Mn, B, Cu, Mo, Cl.





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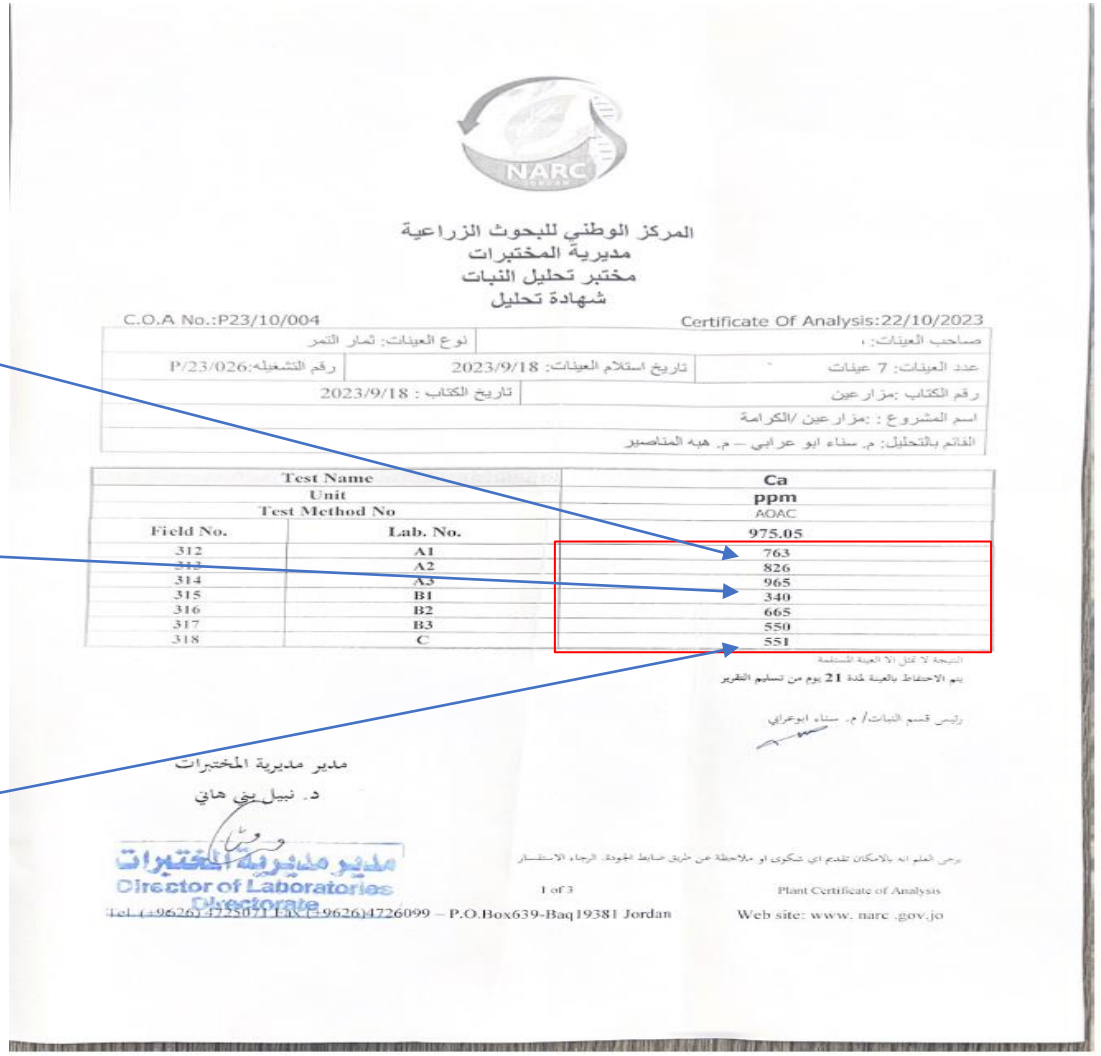
AVERAGE CONCENTRATIONS OF ESSENTIAL ELEMENTS IN DRY MATTER OF PLANTS

ELEMENT	SYMBOL	AVAILABLE FORM	CONCENTRATION (% Dry Weight)	RELATIVE NUMBER OF ATOMS
Hydrogen	H	H_2O	6.0	60 000 000 .
Carbon	C	CO_2	45.0	35 000 000 .
Oxygen	O	$O_2.H_2O$	45.0	30 000 000 .
Nitrogen	N	NO_3^-, NH_4^+	1.5	1 000 000 .
Potassium	K	K^+	1.0	250 000 .
Calcium	Ca	Ca^{++}	0.5	125 000 .
Magnesium	Mg	Mg^{++}	0.2	80 000 .
Phosphorus	P	$H_2PO_4^-, HPO_4^{--}$	0.2	60 000 .
Sulphur	S	SO_4^-	0.1	30 000 .
Chlorine	Cl	Cl^-	0.01	3 000 .
Boron	B	$BO_3^{---}, B_4O_7^{--}$	0.02	2 000 .
Iron	Fe	Fe^{+++}, Fe^{++}	0.01	2 000 .
Manganese	Mn	Mn^{++}	0.005	1 000 .
Zinc	Zn	Zn^{++}	0.002	300 .
Copper	Cu	Cu^{++}, Cu^+	0.0006	100 .
Molybdenum	Mo	MoO^{----}	0.00001	1 .

Ca level in Date palm fruit

Premium



المركز الوطني للبحوث الزراعية
مديرية المختبرات
مختبر تحليل النبات
شهادة تحليل

C.O.A No.:P23/10/004 Certificate Of Analysis:22/10/2023

صاحب العينات:		نوع العينات: ثمار التمر
عدد العينات: 7 عينات	تاريخ استلام العينات: 2023/9/18	رقم التشغيلة:P/23/026
رقم الكتاب :مزارعين		تاريخ الكتاب : 2023/9/18
اسم المشروع : :مزارعين /الكرامة		
القائم بالتحليل: م. سناء ابو عرابي – م. هبه المناصير		

Test Name		Ca
Unit		ppm
Test Method No		AOAC
Field No.	Lab. No.	975.05
312	A1	763
313	A2	826
314	A3	965
315	B1	340
316	B2	665
317	B3	550
318	C	551

النتيجة لا تمثل الا العينة المستلمة
يتم الاحتفاظ بالعينة لمدة 21 يوم من تسليم التقرير

رئيس قسم النبات/ م. سناء ابوعرابي

مدير مديرية المختبرات
د. نبيل بني هاني

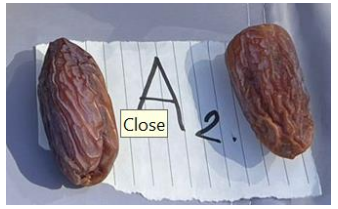
مدير مديرية المختبرات
Director of Laboratories Directorate

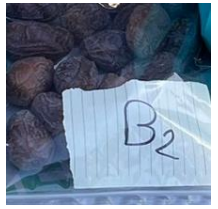
برجى العلم انه بالامكان تقديم اي شكوى او ملاحظة عن طريق ضابط الجودة. الرجاء الاستفسار

1 of 3 Plant Certificate of Analysis

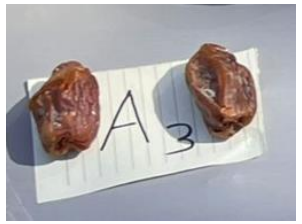
Tel: (+9626) 4725071 Fax: (+9626)4726099 – P.O.Box639-Baq19381 Jordan Web site: www. narc .gov.jo

Delight



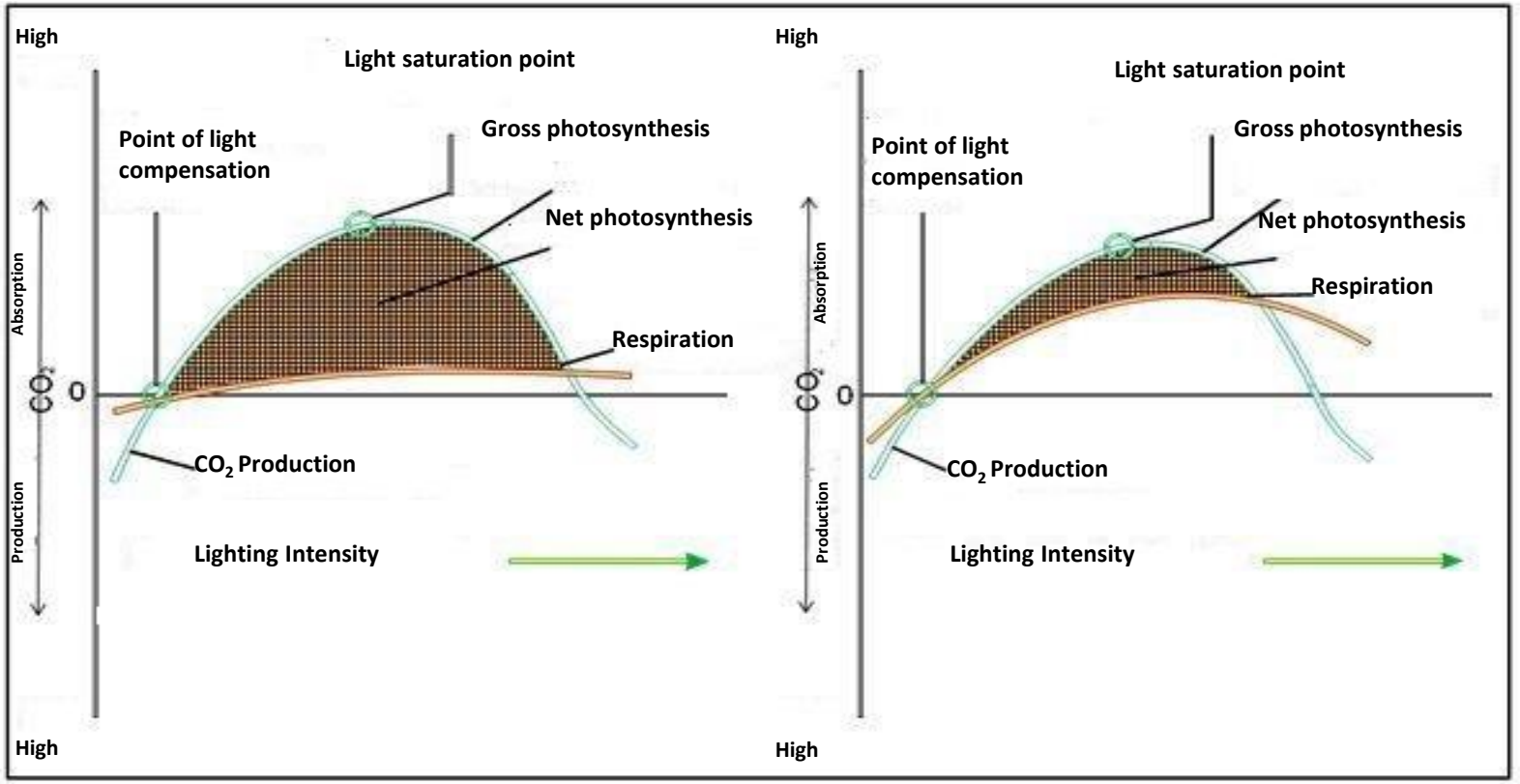


Skin separation



YIELD

Yield = photosynthesis - respiration



Relative amount of net photosynthesis determined by photosynthesis and respiration

Functions of nutrients in Plant

Structural

They are part of cell walls, pigments, amino acids, proteins, carbohydrates and enzymes.

- **C** — **It is part of carbohydrates.**
- **H** — It is part of carbohydrates.
- **O** — **It is part of carbohydrates.**
- **N** — It is part of amino acids and proteins.
- **P** — **It's in phospholipids of membranes, ATP and ADP.**
- **Ca** — It's in Cell walls and membranes, calmodulin.
- **Mg** — **It is part of structure of chlorophyll.**
- **S** — It is a component of amino acids and membranes (sulpholipids).
- **B** — **It is in cell walls**
- **Fe** — It is in chlorophyll and cytochromes.

Mechanisms of nutrients access

Access mechanisms is how the nutrients move to root surface.

Are 3:

1.- Mass Flow: **N, Ca, Mg y B.** The elements in water solution moves from the soil pores into the plant root driven by plant transpiration process.

2.- Diffusion: **P and K** move from a high concentration area into the root with low P,K concentration.
Depends on soil temperature: Higher temperature = Higher diffusion, Lower temperature = diffusion reduction.

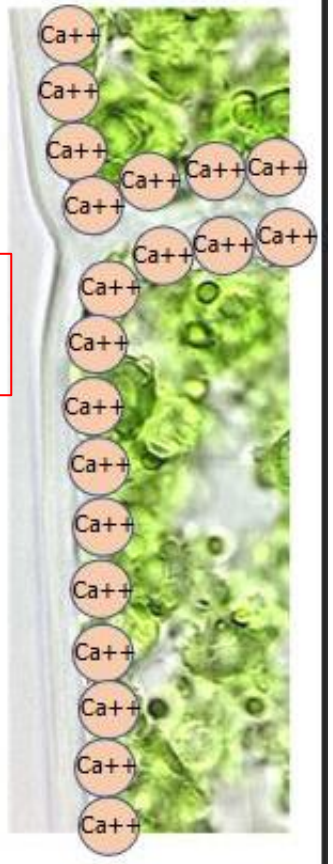
3.- Root interception: **Fe, Zn, Mn, Cu**, the root uptake the nutrients directly.
Depends on a good developed root system.

Mechanisms of nutrients absorption

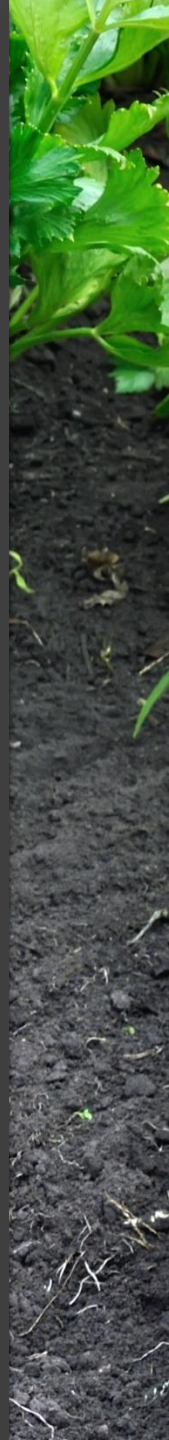
Nutrients absorption is through the cell membrane of the root, maintaining its structural integrity is very important.

One of the most important component to maintain the structural integrity of the cell membranes is Ca++.

When there is calcium deficiency, plant loses the ability of transporting the nutrients, amino acids, carbohydrates and other substances to the interior and is unable to hold the solutes as well, that means, the selective mechanisms of transportation are interrupted.



Factors that affect absorption



Factors that affect absorption

Nutrients introduction through the cell membrane into the xylem is affected by:

1.- Physicochemical characteristics of the ions.

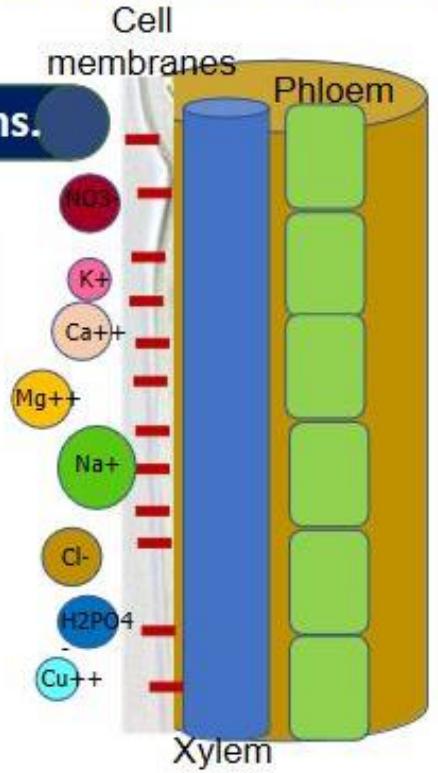
Nutrients interact with cell membrane charges, interaction will depend on the type of charge (+ or -) and number of charges (0, 1,2 or 3)

Movement through the membrane

Cations: $NH_4^+ > K^+ > Mg^{++} > Ca^{++} > Na^-$

Anions: $NO_3^- > Cl^- > SO_4^{--} > H_2PO_4^-$

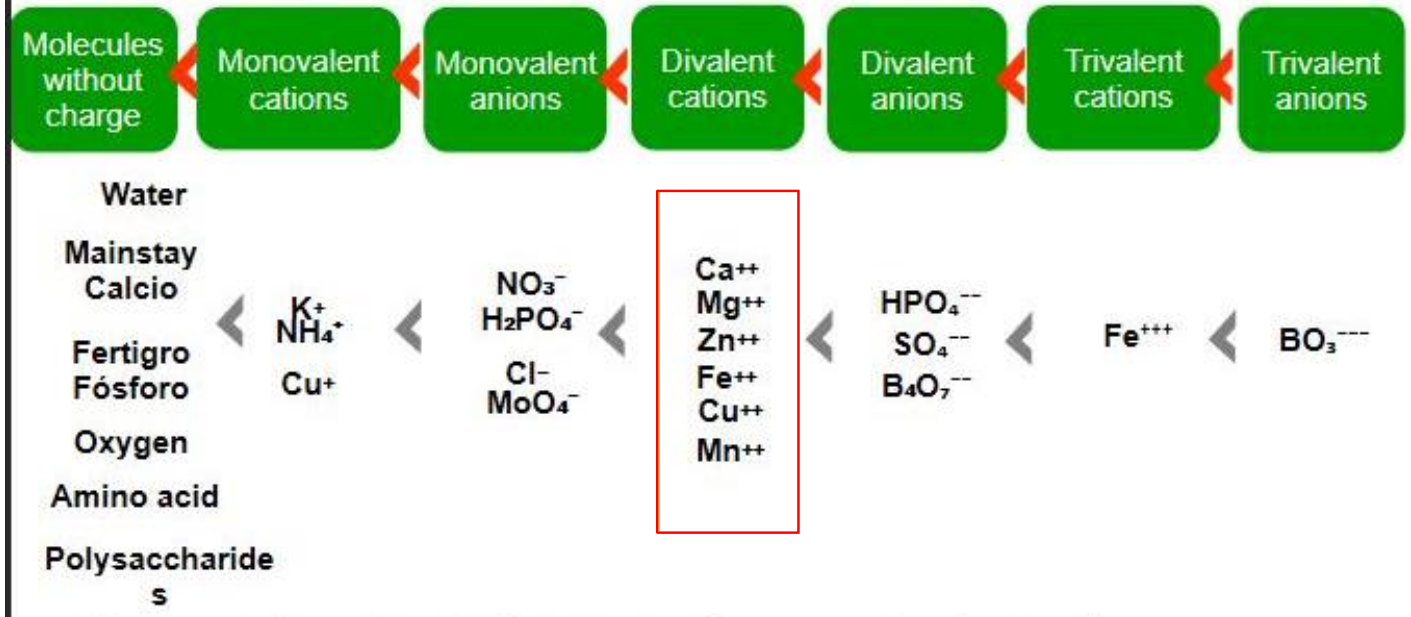
Cations > anions



Factors that affect absorption

1.- Physico-chemical characteristics of ions.

Interaction force increases depending on the following sequence:



The rate of nutrients absorption decreases in that order.

Factors that affect absorption

2.- Antagonisms and Synergisms.

Antagonisms: Competition between ions with similar valency and diameter can be shown in order to occupy the specific places of the carriers.

Synergisms: Stimulation in the absorption of cations by anions and vice versa because of the need of maintain balanced electric charges inside the cells.

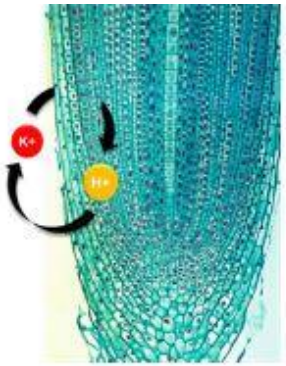
The Ca^{++} stimulates the absorption of cations and anions, because it maintains the stability and integrity of the membranes.

Assimilation of:	Decrease Assimilation of:	Increase Assimilation of:
NH_4^+	Mg, Ca, K	Mn, P, S
NO_3^-	Fe, Zn, Cl	Ca, Mg, K
P	Cu, Zn	Ca
K	Ca, Mg	Mn
P		Mn
Mg	Ca, K	Mo
Fe	Cu, Zn	
Zn	Cu	
Cu	Zn, Mo	
Mn	Zn, Ca, Mo	
Cl	NO_3^-	

Factors that affect absorption

3.- Solution pH

Affects solubility of the ions or compounds formed in the soil solution.



4.- Plant selectivity

Plants needs different nutrients and quantities according to its phenological stage. Example: in first stages needs Nitrogen, in fruit growth stage, needs more Potassium.

5.- Cation : anion ratio

Low nutrient concentration do not affect nutrient absortion.
High nutrient concentration can affect absortion of partner ions.

Factors that affect absorption

6.- External-intenrnal concentration and its status.

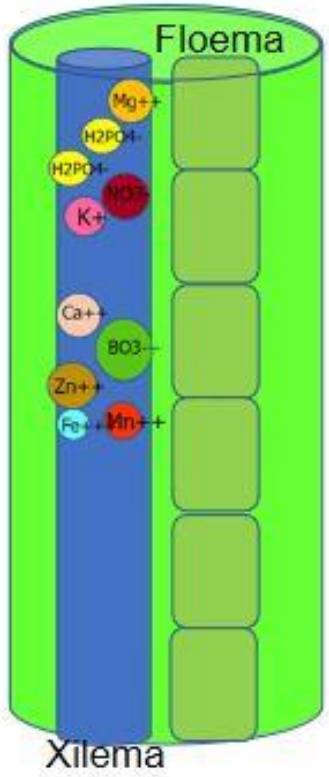
If nutrient concentration increases outside root its absortion do not increases at same level.
If nutrient internal concentration increases its absortion reduces.

Transport of nutrients inside plant

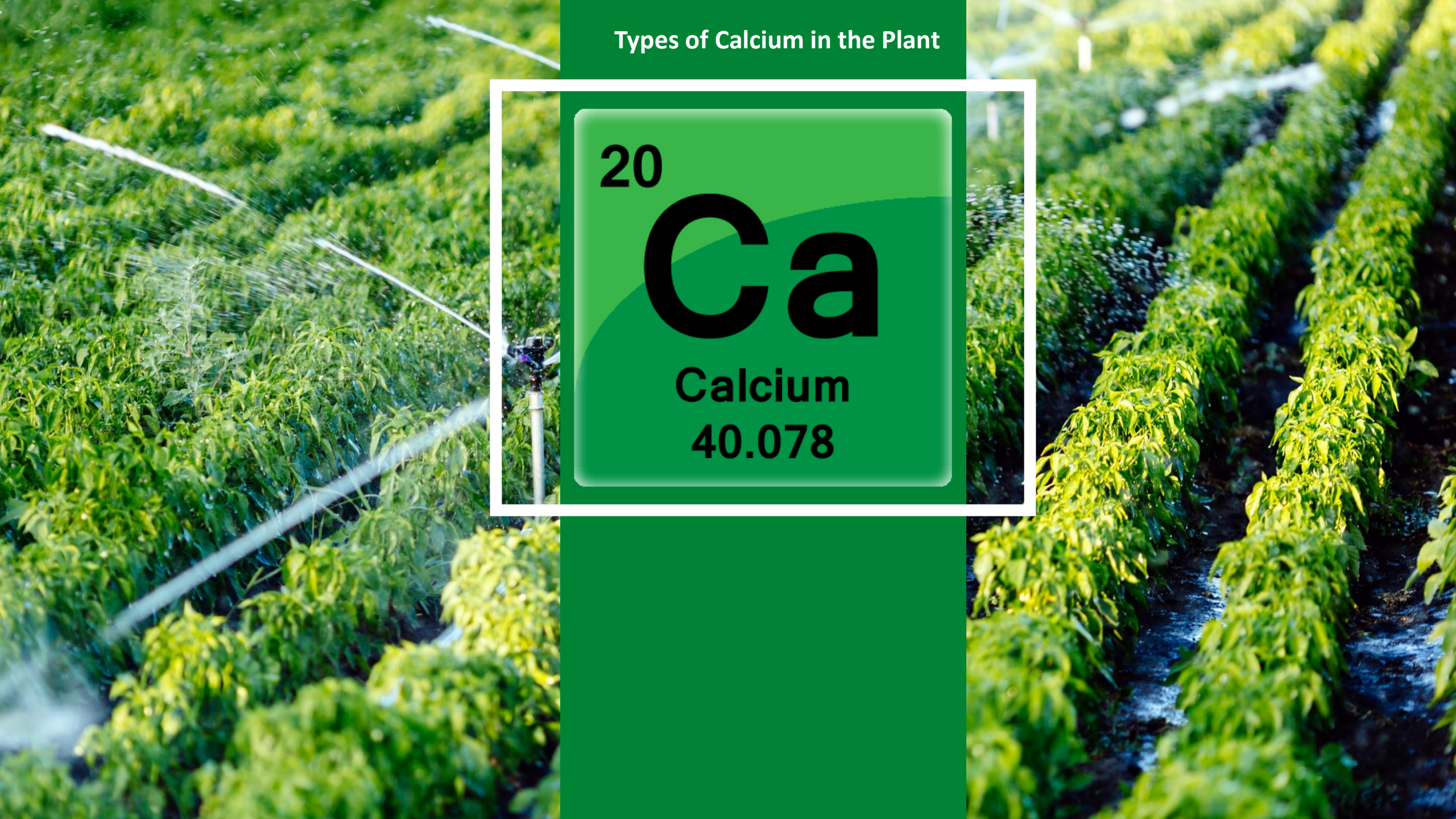
As in the soil there is an interaction between elements, or between elements and colloids, in the xylem there is interaction with the electrical charges (mostly negative) exposed in the walls of the canal, that is why mobility is affected internally.

Elements that are not affected by this interaction and therefore highly mobile within the plant are: N, P, K, Mg.

Mobility of Calcium, B, Fe, Zn, Mn, in the xylem is very low.



Types of Calcium in the Plant



Types of Calcium
in the Plant

Structural Calcium

1. Calcium phosphates

Membrane phospholipids - involved in the regulation of solute uptake and inhibits solute loss under stress.

2. Calcium pectates

Bound Calcium - mainly responsible for fruit firmness and has been shown to be closely related both to the shelf life of the fruit and to its mechanical resistance to pathogen attack.

Functional Calcium

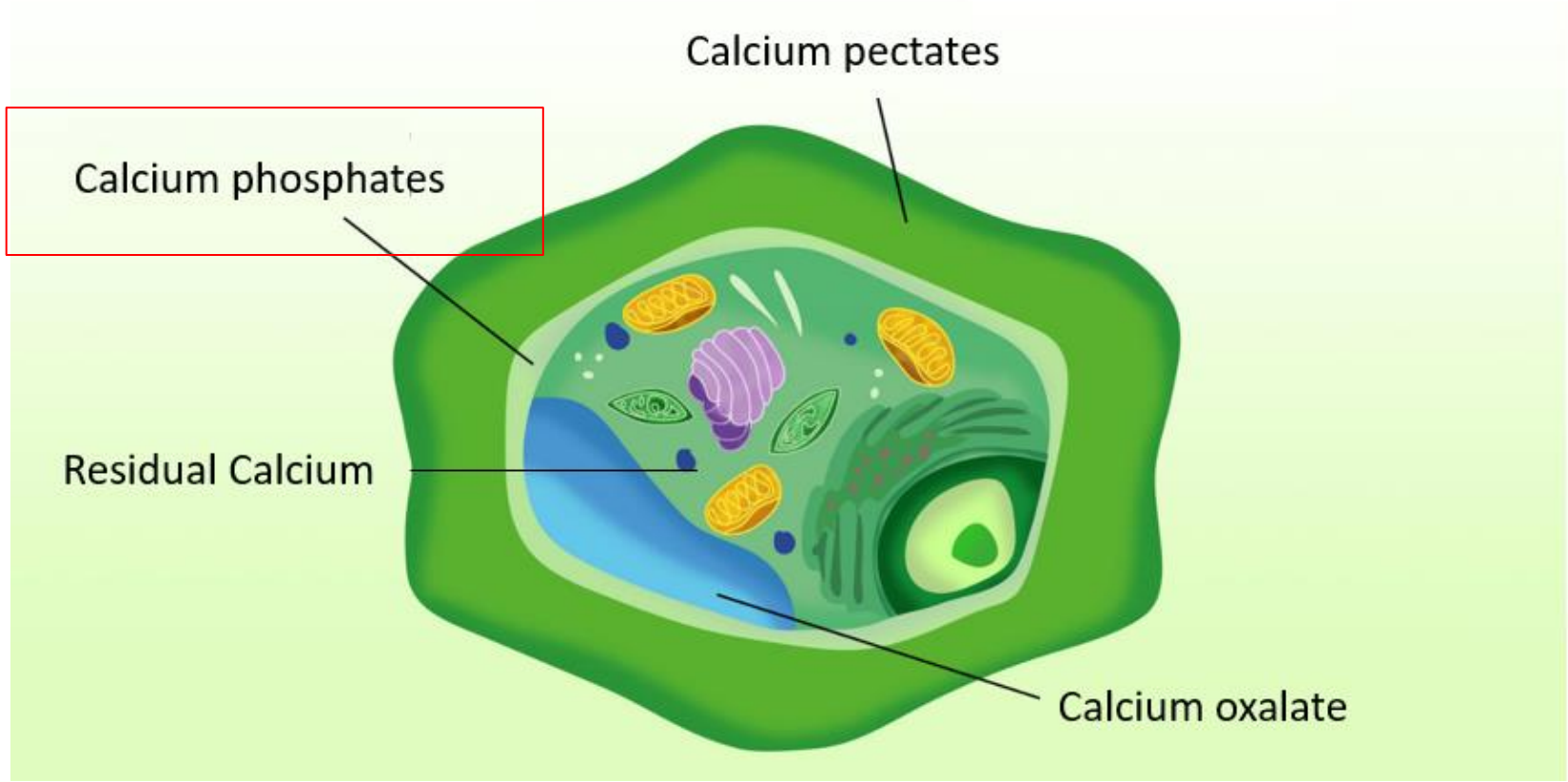
3. Residual Calcium

Free Calcium - in the cytoplasm bound to proteins such as calmodulins that function as a **signaling agent**.

4. Calcium oxalate

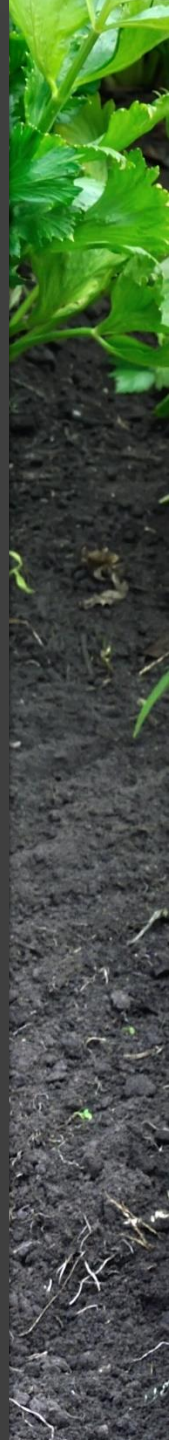
Calcium can become insoluble in the form of **calcium oxalate to be stored** as a reserve in the vacuoles.

Types of Calcium
in the Plant



FUNCTIONS of Ca

Cell wall strength and thickness are increased by calcium addition. Calcium is a critical part of the cell wall that produces strong structural rigidity by forming cross-links within the pectin polysaccharide matrix. With rapid plant growth, the structural integrity of stems that hold flowers and fruit, as well as the quality of the fruit produced, is strongly coupled to calcium availability



FUNCTIONS OF CALCIUM

Structural and Functional Component

Better Size, Uniformity and Fruit Tying

Best Germination Percentage and Seedling Establishment Speed

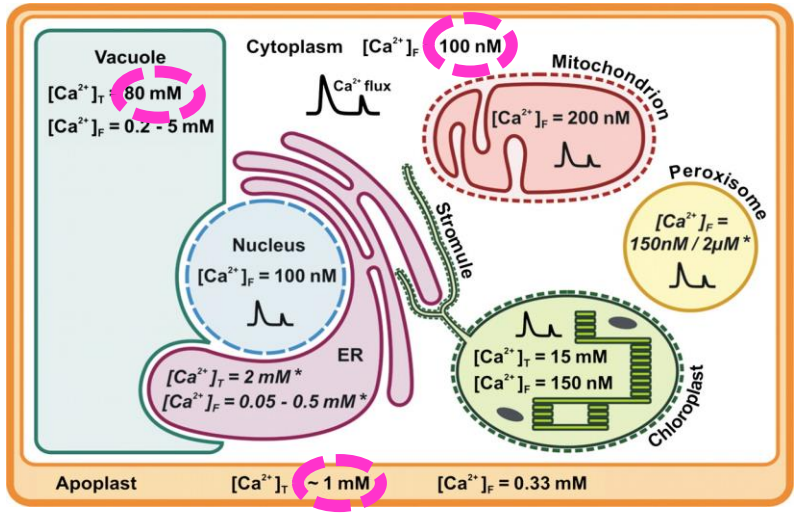
Longer Shelf Life and Fruit Weight

Increased resistance to pests and diseases

Calcium has many functions. It is associated with the development of protein, assists root development and movement of carbohydrates within the plant, and is needed for the formation of cell walls, seed production, and other processes. If the plant is low in calcium, the growth may be adversely affected.

Total Ca & Free Ca

Plants maintain very low levels of free cytosolic Ca2+

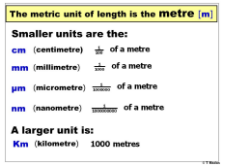


The concentration of free Ca^{2+} is ~ 10,000 times lower in the cytosol than in the apoplast.

The challenge at the plasma membrane is to maintain a low internal free Ca^{2+} (in contrast to the situation for most other nutrients).

Fruit with good signaling related with more dry matter

[Ca2+]T = Total Calcium
[Ca2+]F= Free Calcium



Temporary Wilt or Midday Water Deficit:

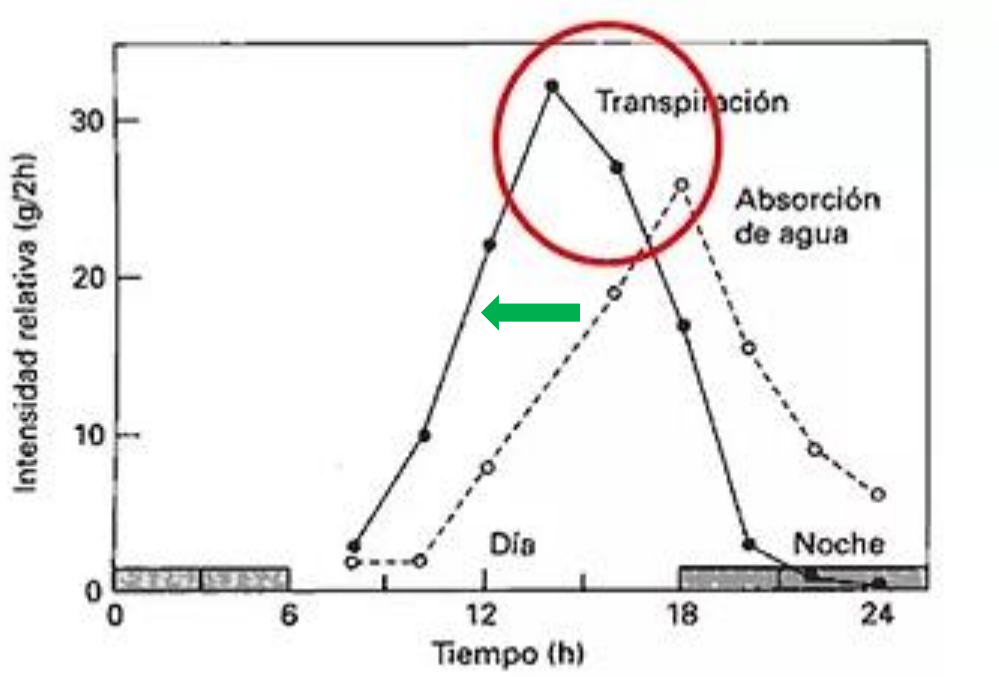


Figure 4-6 Relationship between water absorption and transpiration in the ash tree (data from Kramer, 1937) (Adapted from Azcón-Bieto and Talón, 1993).

It occurs during midday hours, generally in summer when transpiration strongly exceeds absorption. Plants will regain their turgor in the evening hours as long as there is a good availability of water in the soil.

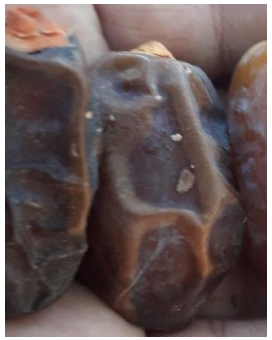
In general, in the morning, water absorption is lower than transpiration and this event results in loss of turgor and wilting by midday; the same happens when plants grow in wet soils.

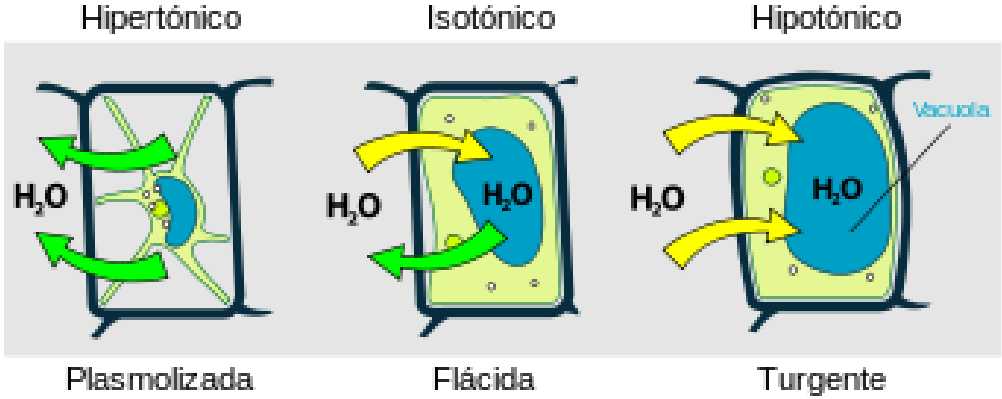
Therefore, water status cannot be predicted from soil moisture measurements, but must be measured directly on the plant.

Osmotic Cellular Adjustment

Stress
(Low dry matter)

Leads to cell death





Plasmolysis in plant cells can cause the plasma membrane to separate from the plant wall, this separation being irreversible.

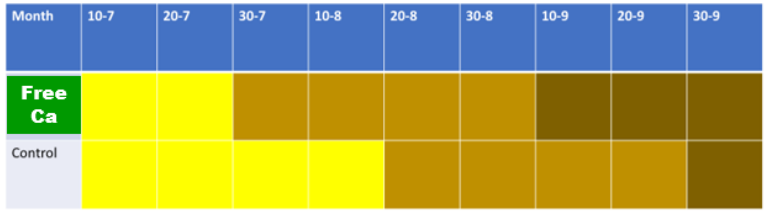
This type of plasmolysis is called **permanent plasmolysis**, it occurs when the cell cannot return to the normal state (irreversible wall separation leads to cell death).

There is also incipient plasmolysis, in which the plant cell loses water but can return to its natural state.

The calcium moiety that binds to the phosphate groups of cell membrane phospholipids (calcium phosphates) is involved in the regulation of solute uptake and inhibits solute loss under stress.

Free Ca Trial &maturation

T1



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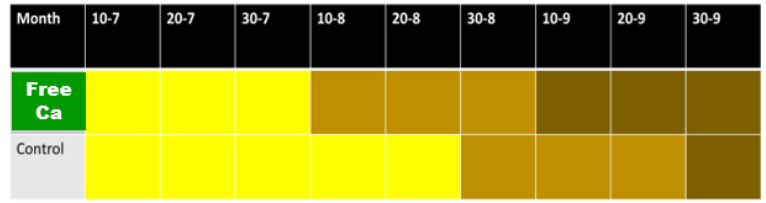

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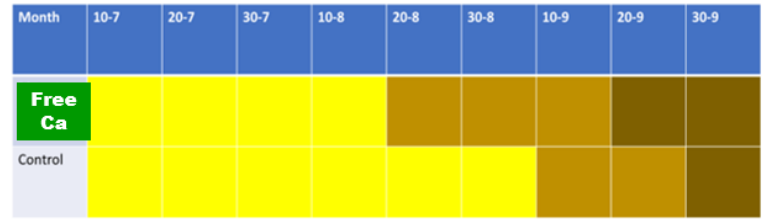
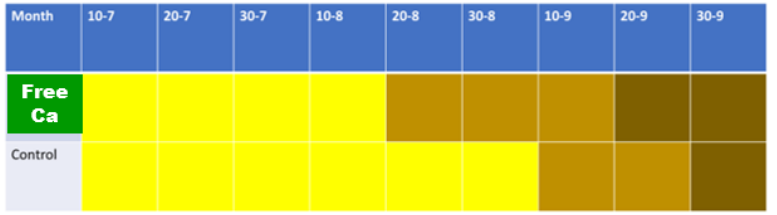
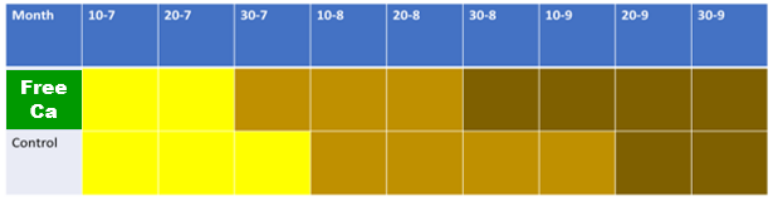


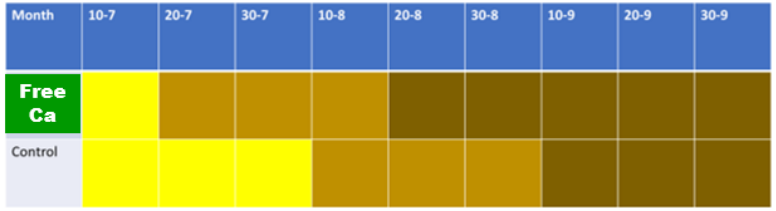
T4



T5



T6



Apply free Ca (during fruit growing) → fast response (signaling) → more dry matter
more tolerance → more quality → color & Maturation

Free Ca Trial :

3 2 1

1	Control
2	Free Ca 50 ml + Other sources of Ca
3	Free Ca 150 ml per tree

المركز الوطني للبحوث الزراعية
مديرية المختبرات
مختبر تحليل النبات
شهادة تحليل

C.O.A No.:P19/10/006 Certificate Of Analysis:20/10/2019

صاحب العينات: نبيل مارون		نوع العينات: نبات – ثمار تمر مجهول
عدد العينات: 3 عينات	تاريخ استلام العينات: 2019/10/3	رقم التشغيله:P/19/113
رقم الكتاب :مزارعين	تاريخ الكتاب : 2019/10/3	
اسم المشروع : :مزارعين		
القائم بالتحليل: م. عربية عربيات – م. بيان الخرابشة		

Test Name		Ca
Unit		ppm
Test Method No		AOAC 975.05
Lab. No.	Field No.	Result
664	1	464
665	2	705
666	3	708

النتيجة لا تمثل الا العينة المستلمة

Ca :

Acts as an enzyme activator , eg -amylase, involved in the germination process.

It controls different physiological aspects of the plant by binding to calmodulin , the enzyme responsible for the plant's anti-stress response (expresses the plant's acclimatization potential, activates heat shock proteins, activates the enzyme dehydrin which enhances dehydration capacity and cell elasticity, etc.) .

Increase accumulated dry matter
Increase elasticity

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Thank you

CONTACT

Muayyad Smadi

+ 096 770200008

muayyad.smadi@cosmocel.com

Regional Commercial Coordinator Middle East

Passion and **Technology**