
balchem
Metalosate®
Palm Oil Metalosate Boron
Roberto Gonzalez

Oil Palm is one of the 16 Crops most sensitive to Boron deficiency

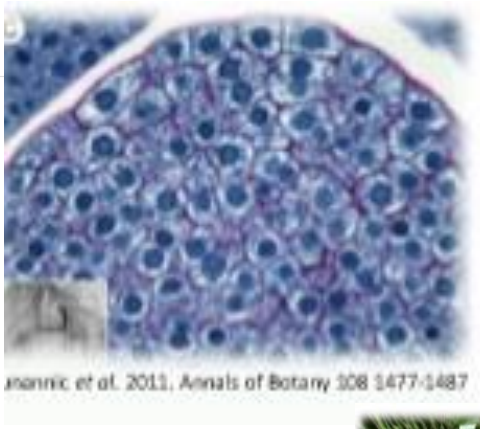
Deficiency leaf and Fruit in Palm Oil

Boron functions

It is part of the cell wall that confers tissue rigidity and resistance to mechanical stress.
B is part of the cell membrane

-B thick cell wall, brittle altered mechanical properties does not expand properly Al accumulation points are generated in roots

-B lower absorption of P in radical leaking points of K, sugars, amino acids and phenols

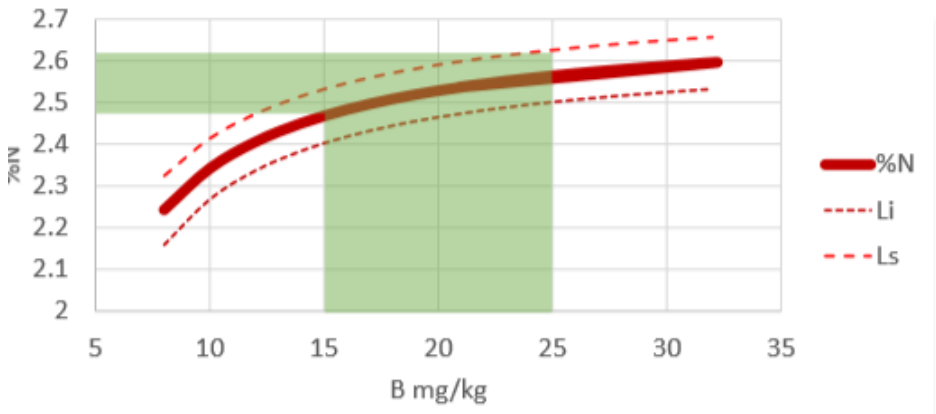


Cell Wall and Plasma Membrane

Boron functions

N metabolism (nitrate reductase)

-B has rapid and profound effects, it triggers changes that are assumed to be $f\ B$:
Transport of sugars
Metabolism of phenols



Ratio model [% N foliar] - [B mg / kg] in sheet 17, based on 500 commercial planting records 2012-13, AIPA, Colombia (2015-2018)

Plant metabolism

Boron functions

-B viability and germination of pollen and elongation of the pollen tube Stigma must provide the B ... it is limited by less transpiration Before symptoms of foliage deficiency it is probable that the pollination or fertilization is deficient

Reproductive growth

Boron functions

sprouts
-B Cessation of elongation and meristematic growth of outbreaks increased AIA is a side effect of -B but is not the one that stops growth

Root elongation and shoot growth

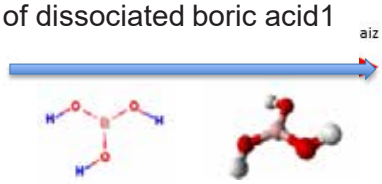
Absorption of boron by plants

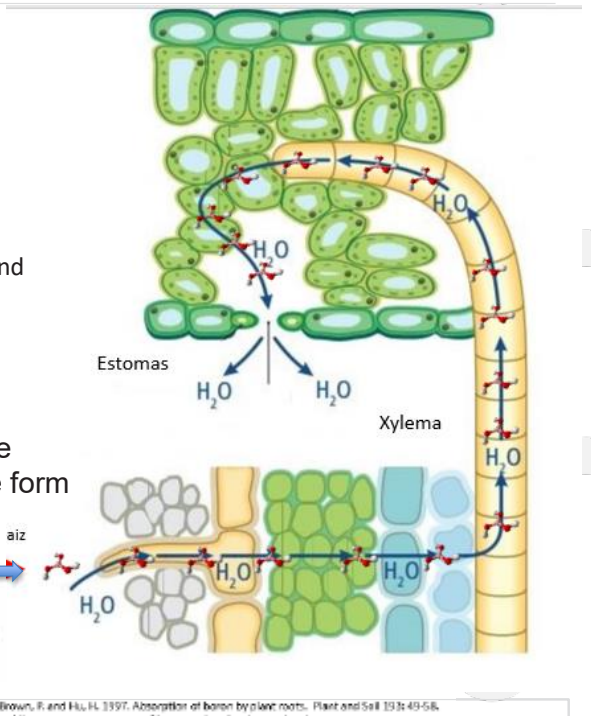
The dissociation of borates in the soil is determined by:

- pH gives solution
- Organic material
- Types of clay
- Humidity of floor
- Soil temperature

These variables determine the amount of B that will be dissociated in boric acid and that will be available in the soil solution for plant absorption.

Plants absorb or boron give solution from the soil in the form of dissociated boric acid1

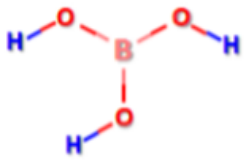




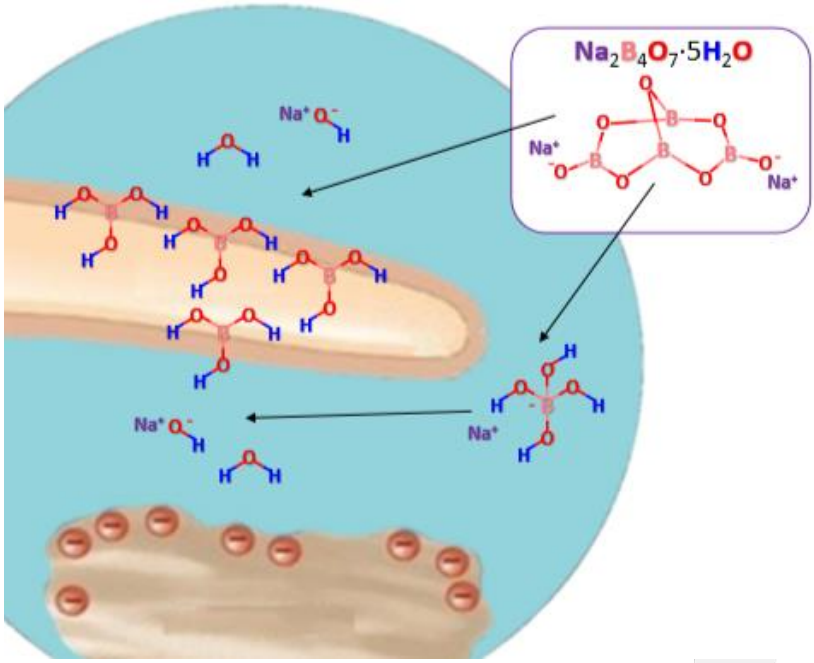
1. Brown, P. and Hu, H. 1997. Absorption of boron by plant roots. Plant and Soil 193: 49-58.
2. Goldberg, S., 1997 Reactions of boron with soils. Plant and Soil 193: 35-48.

Dissociation of sodium tetraborate in the soil solution

Plants absorb boron in the form of B (OH) 3
Dissociation of sodium tetra borate in the soil solution



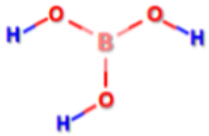
Four B molecules are released into the soil solution as boric acid, which is bioavailable for absorption by plants along with water.



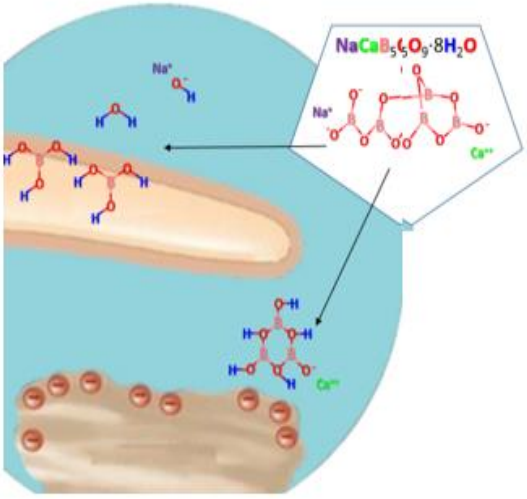
Absorption Boron

Dissociation of sodium and calcium pentaborate in the soil solution

Plants absorb boron in the form of B (OH) 3
Dissociation of sodium and calcium pent borate in the soil solution
NaCaB5O9 · 8H2O



Only two B molecules are released into the soil solution as boric acid, which is bioavailable for absorption by plants along with water



Three B molecules become strongly linked to the Ca ++ molecule, forming a calcium pentahydroxyborate.
The boron contained in this molecule will not be bioavailable for absorption by plants for a very long period.

Absorption Boron

Conditions Associated With Boron Deficiency

Soil

• B adsorbs strongly to amorphous Fe and Al oxides, Mg hydroxide and MO
• B that is not adsorbed is highly susceptible to leaching

• B-poor soil (<0.5 mg / l):

• coarse textures (sandy)

• low MO (<2.5%) ~ controlled release of B • organic soils (peat) • very old (no deposition of rejuvenating materials such as ash or alluvium)

• high fertility or fertilization with N, K, Ca • 4.5 <pH> 7.5

Crops

• Highly productive and nutrient-demanding materials (N, P, K)

• Diseases that affect the radical system

• Little perspiration ...

Weather

• Water deficit

• Heavy, abundant or irregularly distributed precipitation

Palm Oil deficiency Boron

Soil pH affects the absorption of Boron

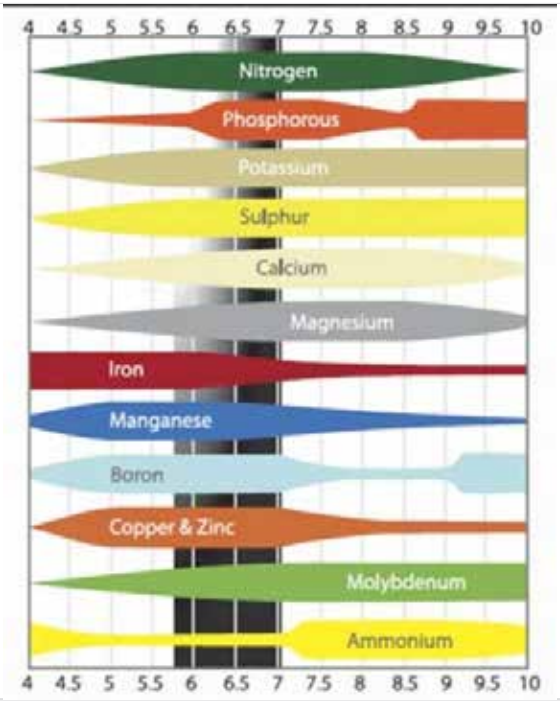


Table pH

Peat Soil

The pH is very acidic that does not allow the absorption of microelements

The high content of organic matter sequesters the microelements

Picture Indonesia

Peat Soil

Sandy Soil

Absorption of nutrients is limited and easily leached

Boron Deficiency

Curly Leaf

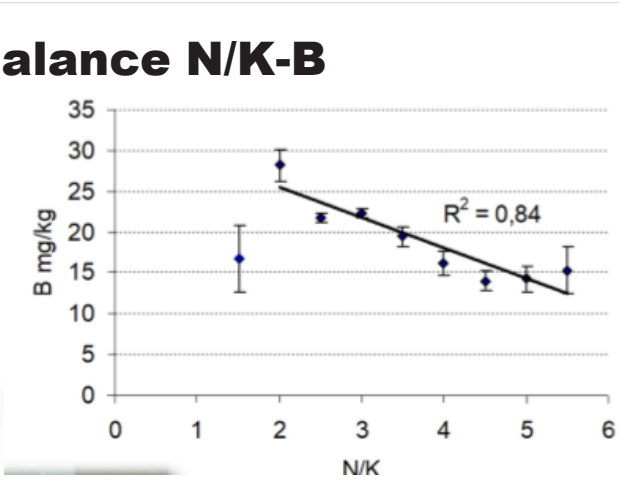
Boron Deficiency

Blind Leaf

Boron Deficiency

White Strip Leaf

White Strip Leaf



Boron Deficiency

Boron Deficiency

Hook leaf

Boron Deficiency

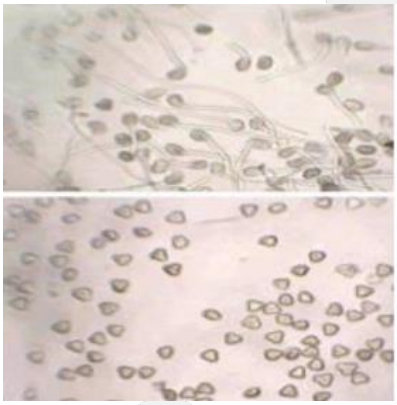
Bonefish Leaf

Boron deficiency leads to decreased pollination

Anthesis period 1 - 5 days

Pollen Viability: Boron deficiency reduces pollen germination and male sterility. Oil palm - reduced viability due to weather

Anthesis Period 1 - 3 days The highest pollination activity occurs on the day



Sprouted and non-sprouted pollen

Dr Ramles Moslin

Boron deficiency produces a low pollination of the Fruits

Good pollination 70% or more Fruit

Medium Pollination 30%- 70% Fruit

Low Pollination 30% or less Fruit

Dr Ramles Moslin

Boron deficiency in fresh fruits leads to parthenocarpic fruits (seedless), small fruits

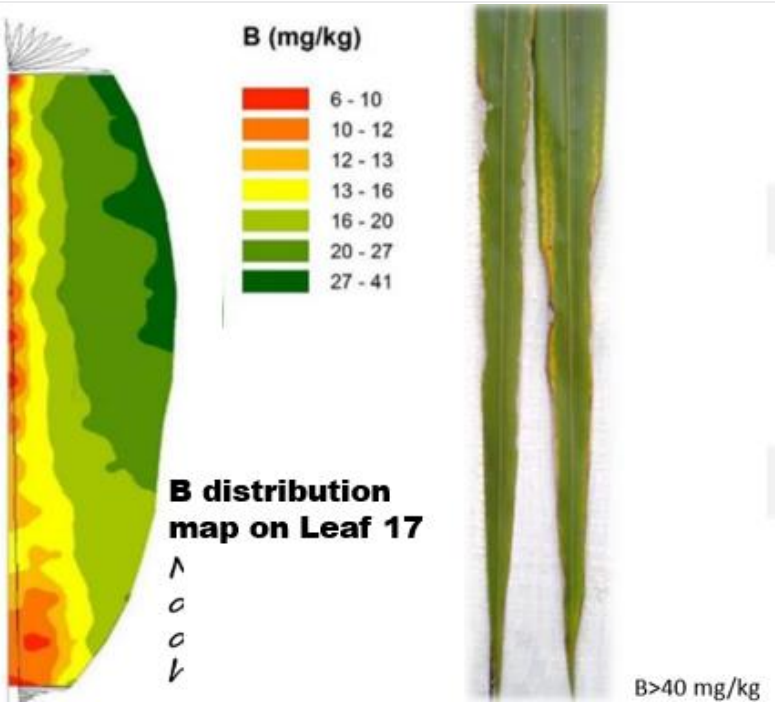
Boron Deficiency

Cause of Boron Toxicity

- Concentrated application
- Armpit application: it is associated with a rapid absorption of B but increases the risk of toxicity
- Application of B in summer: in the soil the B is concentrated (OM, restitution) and with the first rains the availability can be very high
- In nursery: application of B with limited irrigation
- Irrigation water with high [B]

Boron Toxicity

Symptoms of Toxicity



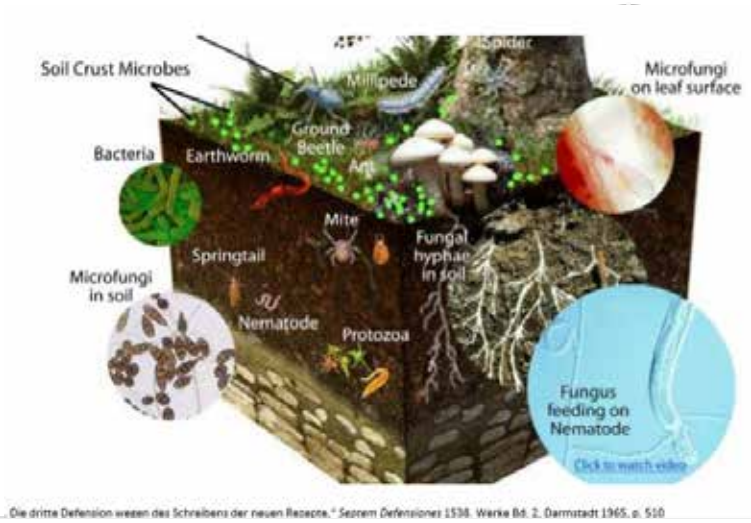
Toxicity Boron

Boron Toxicity

Boron toxicity in nursery

Biocide in high concentrations Boron

"All things are poisonous and nothing is without poison, it is the dose that makes the poison". Paracelsus



Die dritte Defension wegen des Schreibens der neuen Rezepte." *Septem Defensiones* 1538. Werke Bd. 2. Darmstadt 1965. p. 510

Toxic Boron High concentration in Soil

Effect toxic high Concentration Boron

Em 2010, Leonie Becker, Adam Scheffczyk, Bernhard Förster, Jörg Oehlmann, Juliska Princz, Jörg Römbke e Thomas Moser do Instituto Soil Science and Soil Conservation, Research Centre for BioSystems, Land Use and Nutrition de Alemania avaliaron o efeito do acido borico em varios macro e microorganismos

Test organism	Endpoint	EC_{50} (l/u 95% cl) [mg/kg soil (dw)]
Nitrogen transformation	Nitrate formation	>2,400
Avena sativa	Biomass fw; Shoot length	182 (119/281); 308 (n. d.)
Brassica napus	Biomass fw; Shoot length	175 (164/187); 357 (354/361)
Caenorhabditis elegans	Reproduction	747 (589/949)
Enchytraeus crypticus	Reproduction	220 (208/233)
Enchytraeus luxuriosus	Reproduction	228 (201/259)
Eisenia fetida	Reproduction	484 (465/504)
Folsomia candida	Avoidance	1,441 (183/478,293)
Poecilus cupreus	Food uptake	1,342 (249/27,465)

Amount of information on the toxicity of boric acid to soil organisms (including microbes and plants) is sufficient to support the idea of using this chemical as a reference substance in terrestrial Eco toxicological tests.

Toxicity Boron

What are the effects of boron on organisms in the environment?

Table: "Reported critical boron levels for several types of environmental organism"

Type of organism	Type of effect(s) reported	Boron concentration in the water
Bacteria	Mixture of **acute** and **chronic** effects, for several types of bacteria	8 - 340 mg/litre (mainly above 18 mg/litre)
Protozoa	First very small effects, for 2 types of protozoa	0.3 - 18 mg/litre
Freshwater green algae	Highest concentration with no effect (**NOEC**), for several types of algae	10 - 24 mg/litre
Blue-green algae	First very small effect for 1 type of blue-green algae	20 mg/litre
Invertebrates	**Acute** effects for several types of invertebrates	95 to 1376 mg/litre (mainly 100-200 mg/litre)
Water flea (Daphnia magna)	Highest concentration with no effect (**NOEC**), found in many **chronic** tests for this one invertebrate type	6 - 10 mg/litre
Fish	**Acute** effects in several types of fish	10 to nearly 300 mg/litre
Rainbow trout	Chronic tests with standard laboratory water (**NOEC**)	0.009 - 0.103 mg/litre
Rainbow trout	Chronic tests in several natural waters (**NOEC**)	0.75 - > 18 mg/litre

The data in the table show that **bacteria** are much less sensitive to boron, compared to other chemicals. Protozoa are somewhat more sensitive. **Algae**, for which boron is an essential nutrient, also have low sensitivity to boron. **Invertebrates** also have a low boron sensitivity, as determined from many long-term studies. **Fish** are the most sensitive species to boron.

PROTECTION, CONSERVATION AND IMPROVEMENT OF ECOSYSTEMS AND THE ENVIRONMENT

The following **eight principles** must be observed by RSPO members:

Boron Management Problems

Ensuring an adequate supply and absorption of B throughout the year constitutes the main challenge for the management of B in oil palm

1- Leaf chemical analysis of the leaf (1, 3, 9, 17): allows monitoring [B] on the sampling leaf shows the “accumulated history” on the leaf does not indicate the status of B in sensitive tissues (meristems) Symptoms of deficiency of B in leaf 1, reveal the deficit in the supply of B until 5 months ago, when the now visible tissue was in the bud

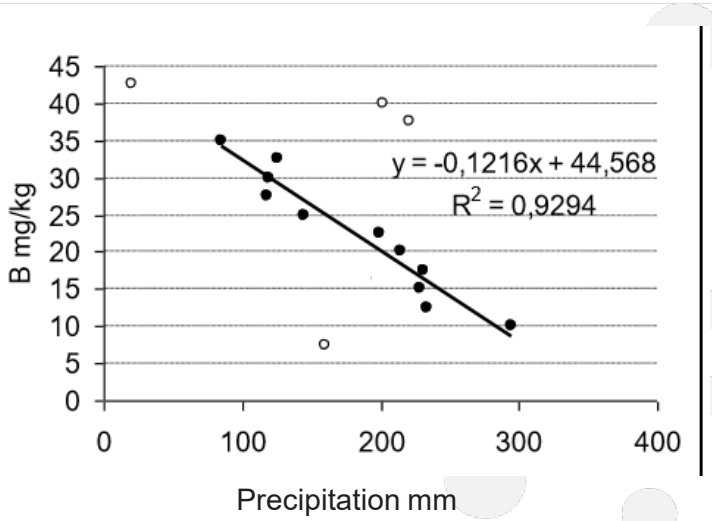
2- Water deficit there may be high [B] in the soil, but there is no absorption.

3- Strong precipitation events

Boron in Palm Oil

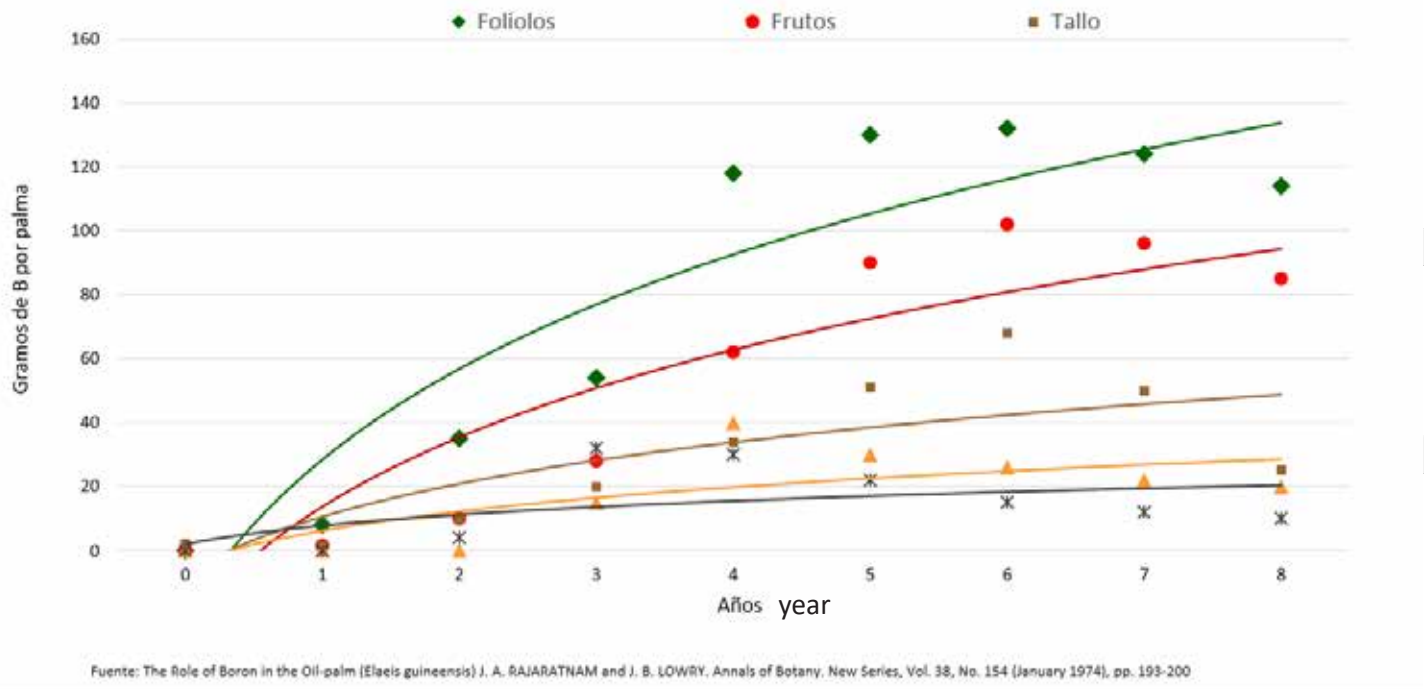
Strong Events of Precipitation and Boron

- dilute the B concentration of the soil solution
- B leaches from the zone of radical activity
- restitution from MO and other soil minerals is not fast
- transitory deficit of 1-2 days is already reflected in deformations when the sheet expands (Broshat 2005)



Boron in Palm Oil

Average Boron Demand in Palm Oil



Fuente: The Role of Boron in the Oil-palm (Elaeis guineensis) J. A. RAJARATNAM and J. B. LOWRY. Annals of Botany. New Series, Vol. 38, No. 154 (January 1974), pp. 193-200

Foliolo=Leaf , Frutos Leaf Tallos=Steam

Symptoms of B deficiency and toxicity can be found in the same leaf

symptoms originate at different times of the leaf age

Bioavailability of Soil Boron

Application of a Boron Complex Foliar

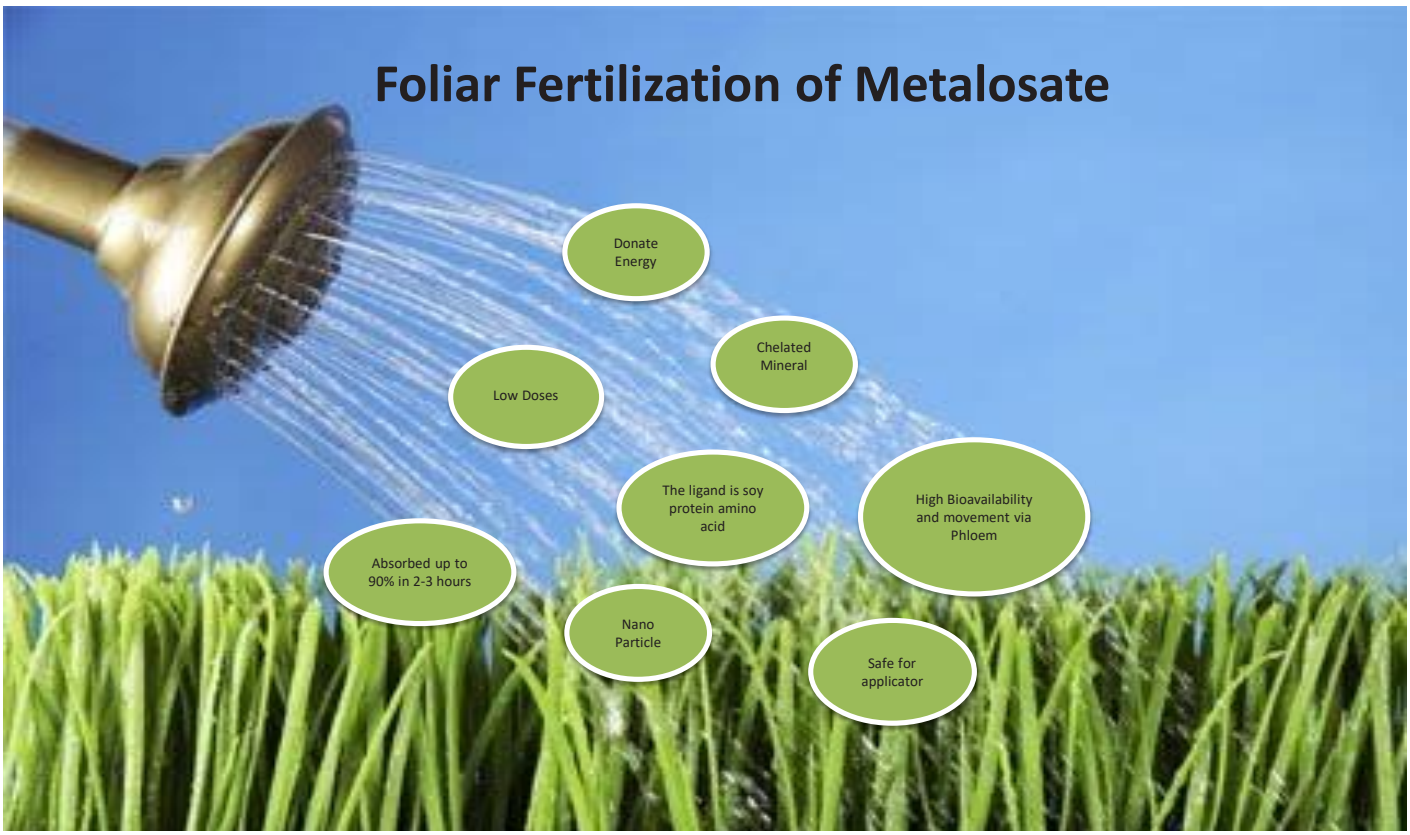
Spraying Boron in Palm Oil

Metalosate Boron

Aminoacid Complex Boron

What is ? Metalosate

- **A specific chelate mineral fertilizer designed to satisfy and improve nutrients in plants**
- **The chelates used by Metalosate are Amino Acid the soy bean, where amino acids are the main ingredient for the production of proteins**


Foliar Fertilization of Metalosate
Donate Energy
Chelated Mineral
Low Doses
The ligand is soy protein amino acid
High Bioavailability and movement via Phloem
Absorbed up to 90% in 2-3 hours
Nano Particle
Safe for applicator

Research plantations Indonesia

PT. Peniti Sungai Purun

Metalosate Boron Application

0 Day

120 Day

Spraying Metalosate Boron

Metalosate Boron Application

Spraying Metalosate Boron

Metalosate Boron Application

Spraying Metalosate Boron

Applications Metalosate Boron

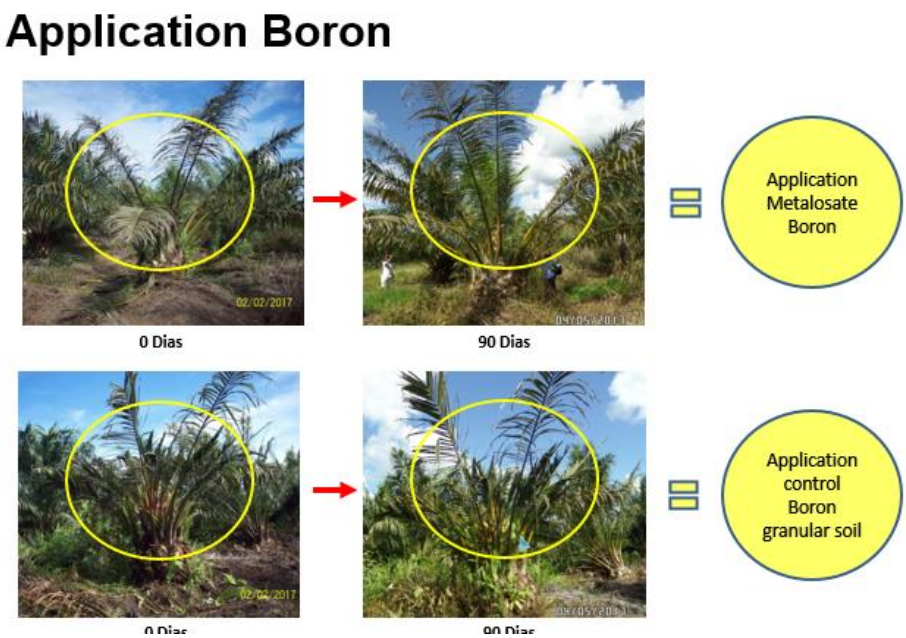
Time	Treatment		
	Metalosate Boron, 1 application interval 6 month	Metalosate Boron , 1 applicate interval 12 month	Control (Boron Granular)
0 Day			
90 Days			

Spraying Metalosate Boron

Metalosate Boron Application

Spraying Metalosate Boron

Applications Metalosate Boron



Spraying Metalosate Boron

60 day After Application

Metalosate Boron 1 l/ha

Boron Granular 80 gr/ plant

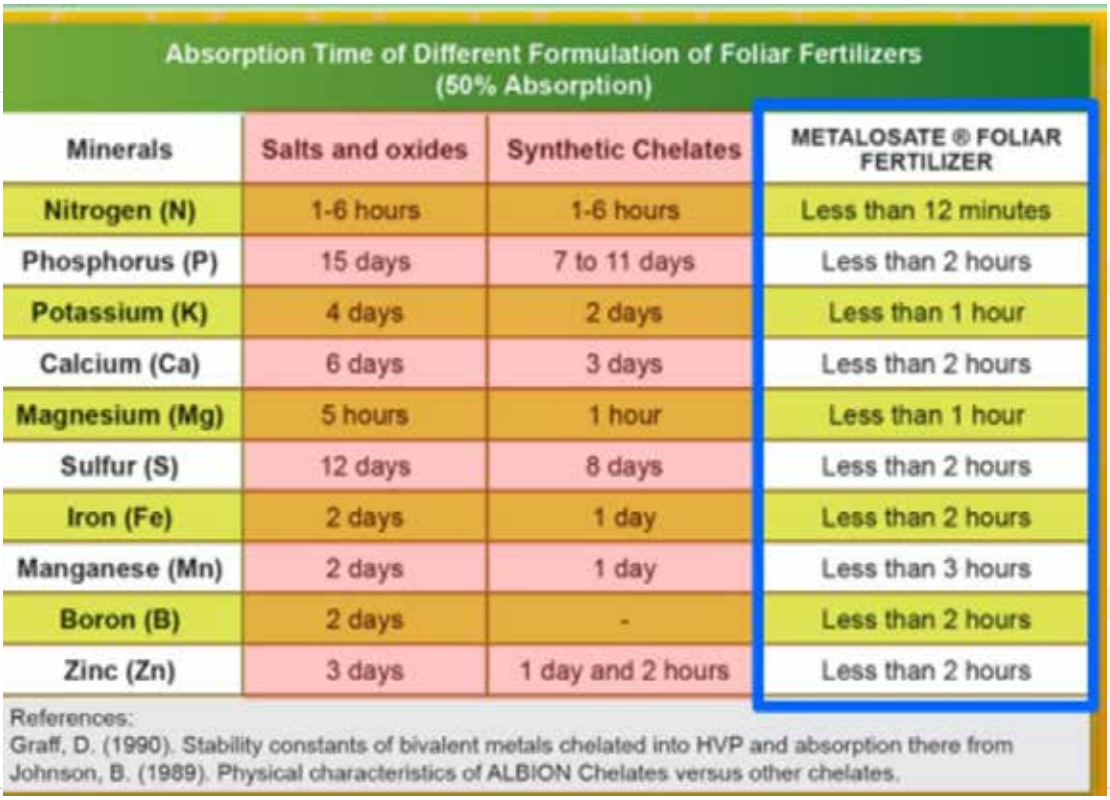
Honduras Central America

Application Metalosate

Fumigation equipment	Metalosate*	Doses	Lt Water	Interval ha	Application
sprayer pump	• Boron	1 l/Ha	70 lt	180 day	Spread uniformly on one side of the plant by one hectare leaves (1 sprayed plant ± 0.5 L)
Drone sprayer	• Boron	0.5 l/ha	30 lt	Cada 180 dias	Pulverized on leaves of plants for one hectare (1 sprayed plant ± 0,2 L).

Note * The type of Metalosate used is adapted to the condition of the plant

Metalosate Boron



Absorption Time of Different Formulation of Foliar Fertilizers (50% Absorption)			
Minerals	Salts and oxides	Synthetic Chelates	METALOSATE ® FOLIAR FERTILIZER
Nitrogen (N)	1-6 hours	1-6 hours	Less than 12 minutes
Phosphorus (P)	15 days	7 to 11 days	Less than 2 hours
Potassium (K)	4 days	2 days	Less than 1 hour
Calcium (Ca)	6 days	3 days	Less than 2 hours
Magnesium (Mg)	5 hours	1 hour	Less than 1 hour
Sulfur (S)	12 days	8 days	Less than 2 hours
Iron (Fe)	2 days	1 day	Less than 2 hours
Manganese (Mn)	2 days	1 day	Less than 3 hours
Boron (B)	2 days	-	Less than 2 hours
Zinc (Zn)	3 days	1 day and 2 hours	Less than 2 hours

References:
Graff, D. (1990). Stability constants of bivalent metals chelated into HVP and absorption there from
Johnson, B. (1989). Physical characteristics of ALBION Chelates versus other chelates.

Metalosate Boron

Metalosate

Metalosate: Micronutrients chelated by amino acids designed for foliar application to crops

Metalosate Boron

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PLANT NUTRITION

balchem.com/plant-nutrition