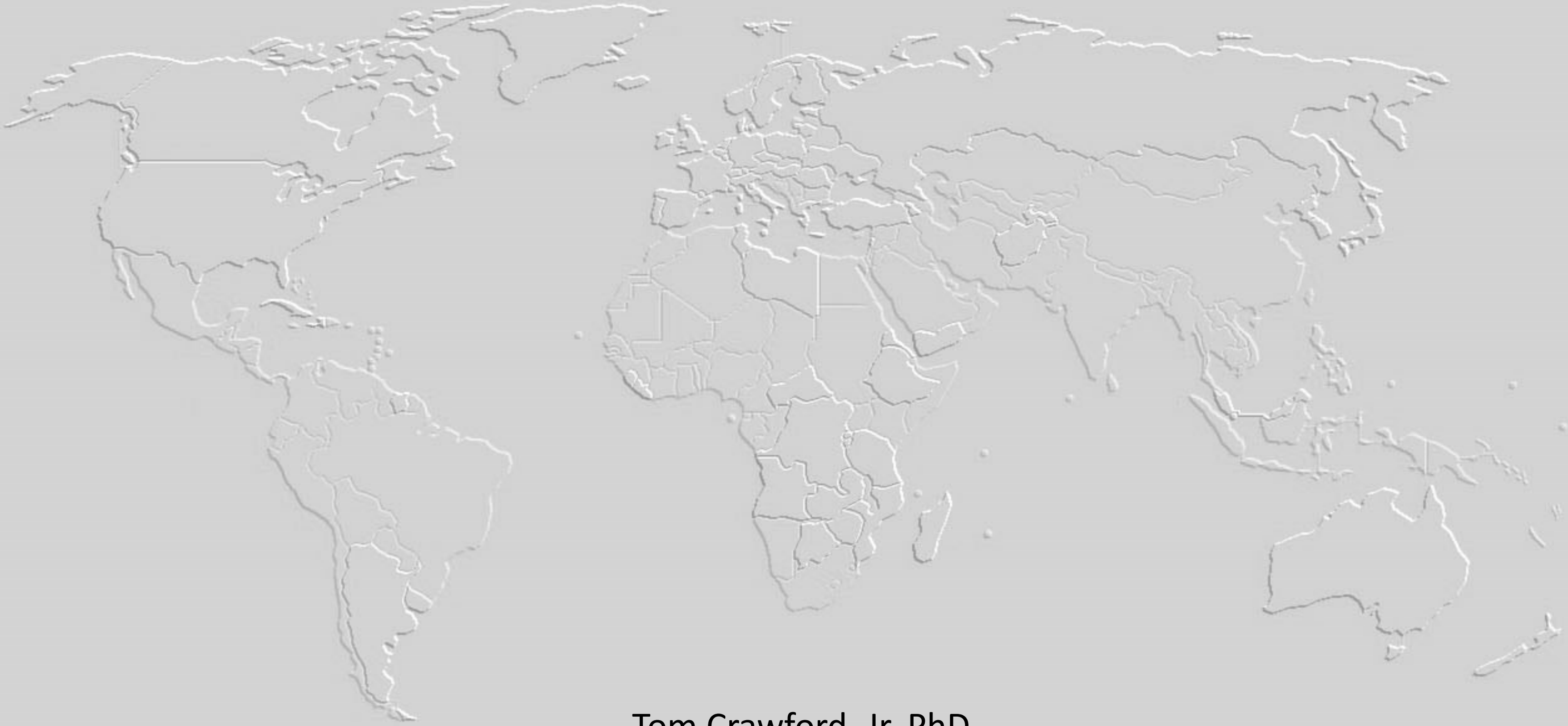
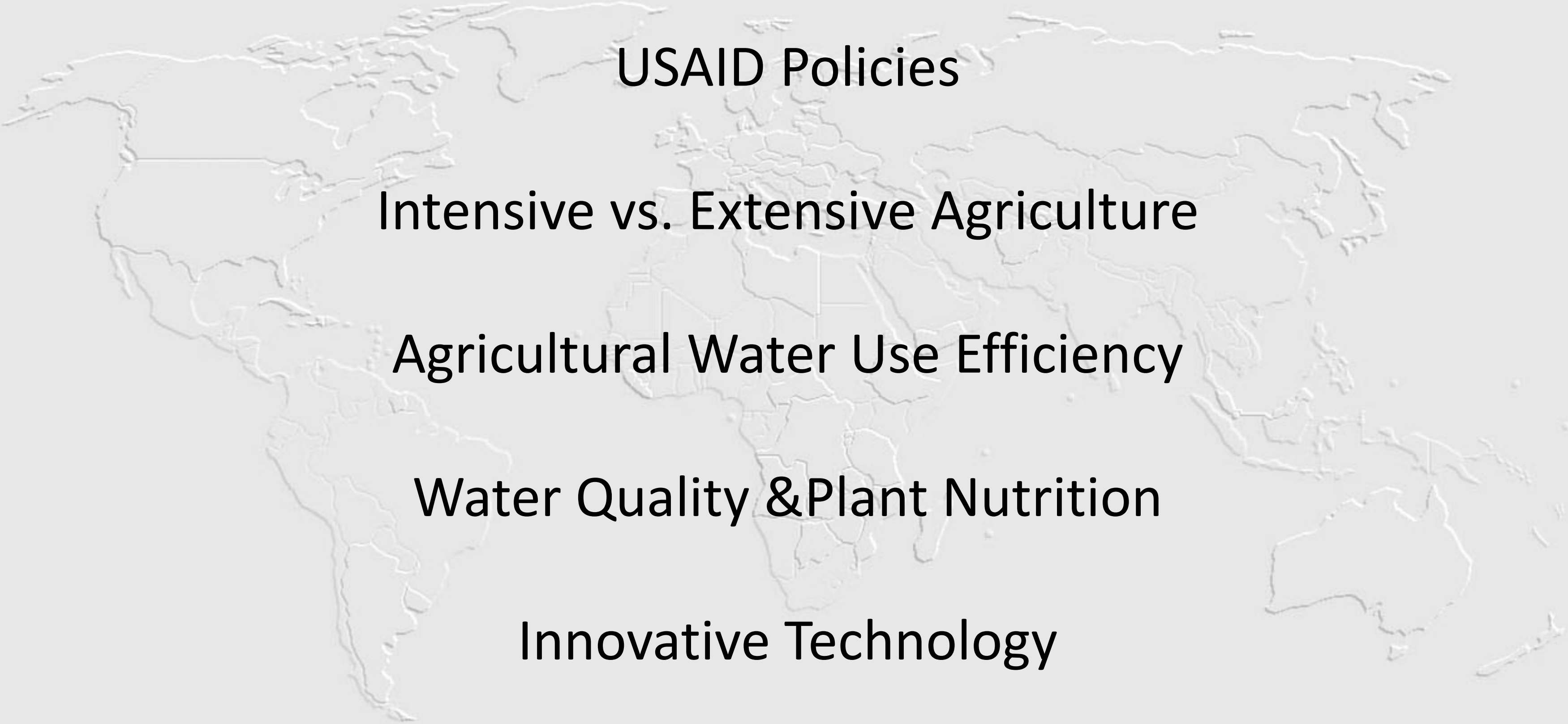
How Irrigation Water Quality and Crop Nutrition Impact Food Security in Developing Countries



Tom Crawford, Jr, PhD
Bio Huma Netics, Inc.
Washington, DC, October 23, 2013



Food Security

USAID Policies

Intensive vs. Extensive Agriculture

Agricultural Water Use Efficiency

Water Quality &Plant Nutrition

Innovative Technology

Sustainable & Profitable Value Chains

What is Food Security?

Food security is considered to exist when the following four components (pillars) have been attained:

- **Availability**: Families and individuals require a reliable and consistent source of quality food.
- **Access:** Sufficient resources (purchasing power) to purchase quality foods.
- **Utilization:** People need to have knowledge and basic sanitary conditions in order to choose, prepare and distribute the quality foods in a manner that results in good nutrition for all family members.
- **Stability:** A stable and sustainable environment (social, political and economy) must exist in order to ensure that families and individuals have the availability, access and utilization of quality and nutritious foods.

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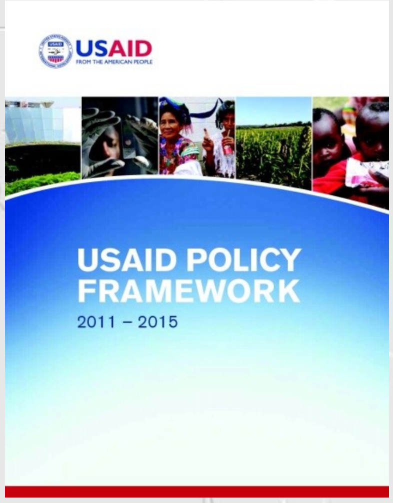
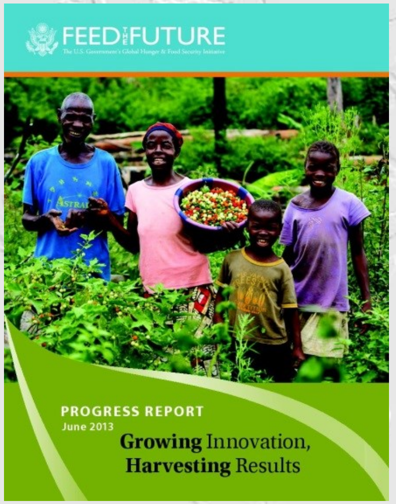
USAID Policies Support Food Security and Improved Management of Water



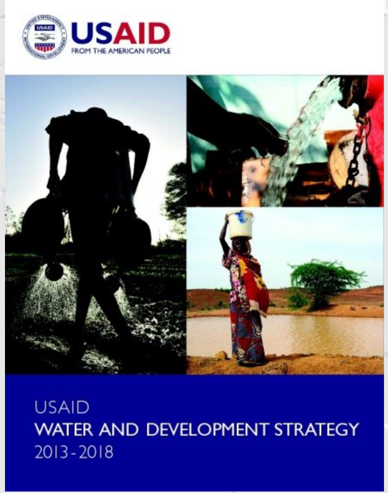
USAID
FROM THE AMERICAN PEOPLE

USAID POLICY FRAMEWORK
2011 – 2015



FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

PROGRESS REPORT
June 2013
Growing Innovation, Harvesting Results



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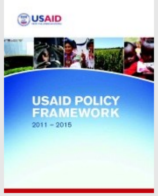
USAID
WATER AND DEVELOPMENT STRATEGY
2013-2018

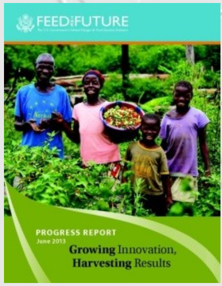

USAID

USAID POLICY FRAMEWORK

2011 – 2015

USAID Policy Framework 2011-2015

“APPLY SCIENCE, TECHNOLOGY, AND INNOVATION STRATEGICALLY.”


FEED THE FUTURE

PROGRESS REPORT

June 2013

Growing Innovation, **Harvesting** Results

“Scientific innovation and technology are critical to meeting the global challenges of producing more food with less **land** and **water** and helping farmers adapt to climatic, social and economic shocks.”

USG's Feed the Future Policy Supports Application of Scientific Innovation and Technology for Intensification of Agriculture

Sub-Saharan Africa – 40 years of *extensive* cereal production

Asia – 40 years of ***intensive*** cereal production

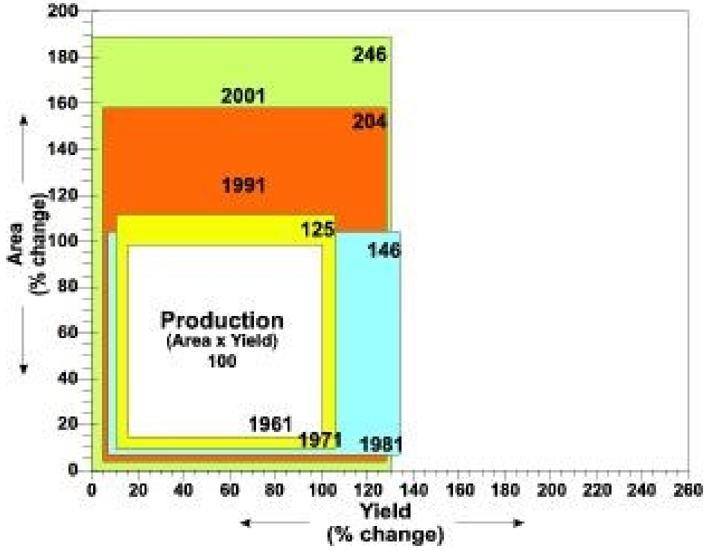


Figure 2. Changes in Cereal Production in Sub-Saharan Africa Due to Changes in Area and Yield (1961 = 100)

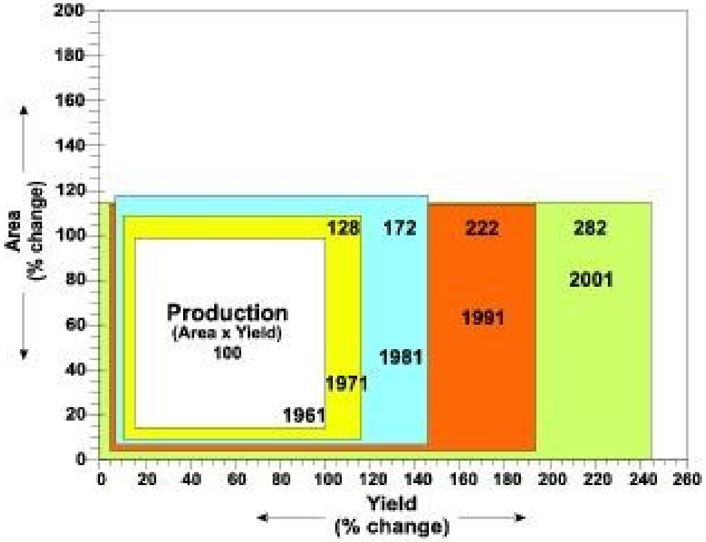


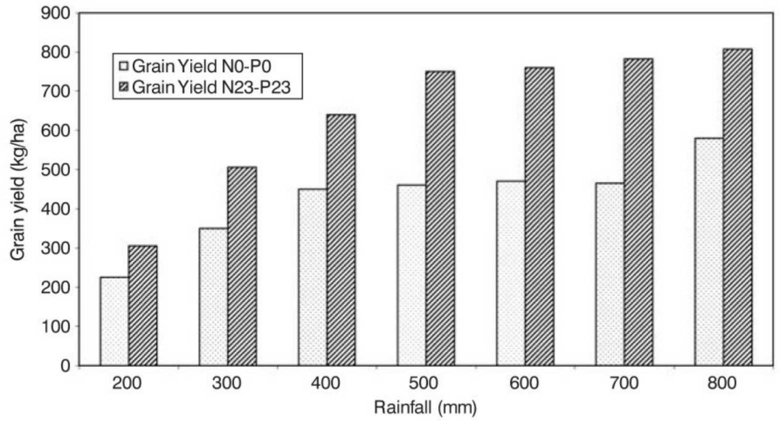
Figure 3. Change in Cereal Production in Asia Due to Changes in Area and Yield (1961 = 100)

Source: Henao, Julio and Carlos Baanante. 2006. Agricultural Production and Soil Nutrient Mining in Africa: Implications for Resource Conservation and Policy Development, IFDC-An International Center for Soil Fertility and Agricultural Development, Muscle Shoals, Alabama, USA

Intensification of Pearl Millet Production in Niger
Using Irrigation & Fertilizer – No Increase in Area Cultivated

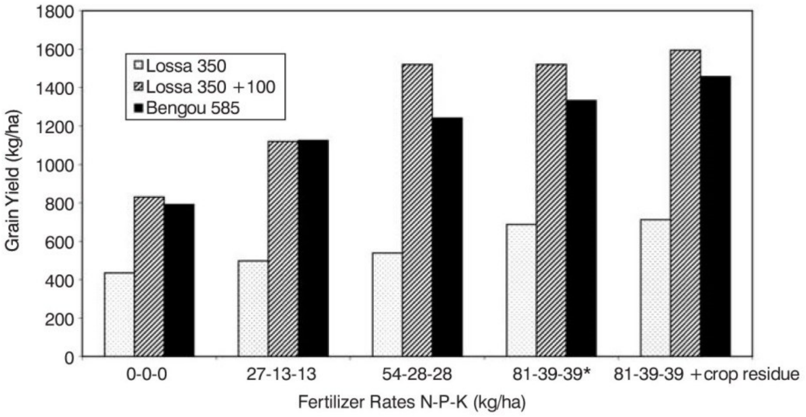
Yield of rainfed pearl millet increased with more rainfall and with N & P fertilization.

FIGURE 6. Pearl millet grain yield response to nitrogen and phosphorus in different rainfall zones in Niger as an average of more than 500 site years.

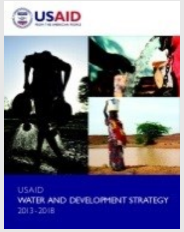


Yield of rainfed pearl millet increased with either greater rainfall or supplementary irrigation and fertilization.

FIGURE 7. Pearl millet grain yield at two rainfall zones in Niger, and effect of supplementary irrigation in the low rainfall zone in 1998.



Source: Pandey, R. K. , Maranville, J. W. and Crawford Jr., T. W. 2001. Agriculture Intensification and Ecologically Sustainable Land Use Systems in Niger: Transition from Traditional to Technologically Sound Practices, Journal of Sustainable Agriculture, 19: 2, 5 — 24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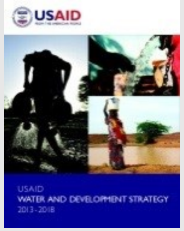
USAID
WATER AND DEVELOPMENT STRATEGY
2013-2018

USAID Water and Development Strategy 2013 - 2018

- Support for Feed the Future
- Strategic Objectives 2013 – 2018
  - SO 1 – Improve health outcomes through the provision of sustainable safe water, sanitation, and hygiene (WASH)
  - SO 2 - Manage water in agriculture sustainably and more productively to enhance food security
    - Intermediate Result 2.1: Improve the efficiency and sustainability of food production from rainfed agricultural systems.
    - Intermediate Result 2.2: Improve the efficiency and sustainability of food production from irrigated agricultural systems.



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Water Use Efficiency, or Productivity, California, 1989 – 2009
WUE = tons/acre-foot applied (35.3% increase, or ~1.76% average increase per annum)

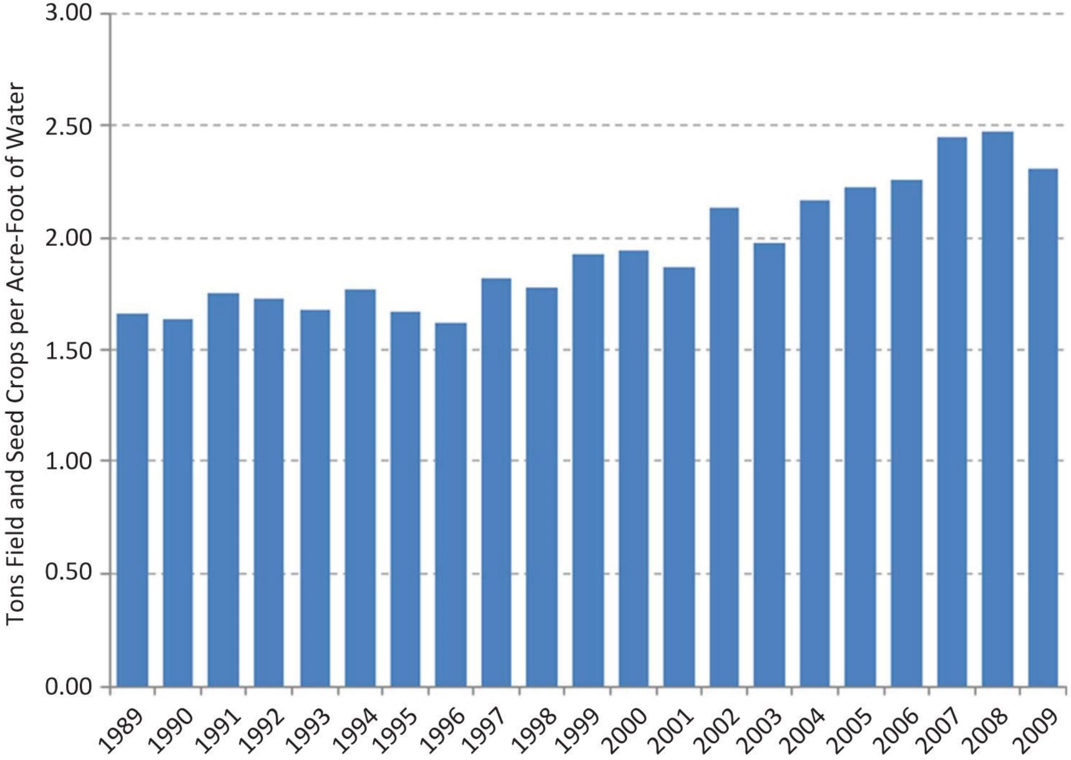

Figure 2. California crop productivity for field/seed crops (tons per acre-foot of water). Productivity has increased from around 1.7 to over 2.3 or more between the late 1980s and 2009 without a comparable increase in total water use for these crops.
Sources: USDA NASS CA Historical Data (1989–2008) and CA Agricultural Statistics Report (2009).

Source: Gleick, Peter H., Juliet Christian-Smith and Heather Cooley. 2011. Water-use efficiency and productivity: rethinking the basin approach. Water International 36:7, 784-798, DOI: 10.1080/02508060.2011.631873

Water Use Efficiency (WUE) and Transpirational Water Use Efficiency (TWUE)

- **Evaporation** (E) – loss of water to the atmosphere.
- **Transpiration** (T) – movement of water through a plant and loss to the atmosphere.

- **WUE** = Yield (Y)/EvapoTranspiration (ET) = Y/ET
  - If Y/T is constant and E↓ (e.g. w/ mulch) then Y/ET↑ so WUE↑
  - If Y↑ (w/ fertilizer, cultivar, water) and ET is constant, WUE↑

- **TWUE**
  - Transpirational WUE, TWUE = Y/T↑
  - If Y/T↑ (fertilizer, cultivar), TWUE ↑

Constraints to Agricultural WUE

- Social, political and economic
  - Laws, regulations, cultural practices, beliefs.
  - Lack of access to inputs & facilities due to lack of investment, infrastructure and functioning value chains.
- Physical and chemical
  - Biotic stresses (e.g. pests, pathogens)
  - Abiotic stresses (e.g. deficiencies or excesses in moisture, temperature, water quality, essential plant nutrients, and other elements in the environment)

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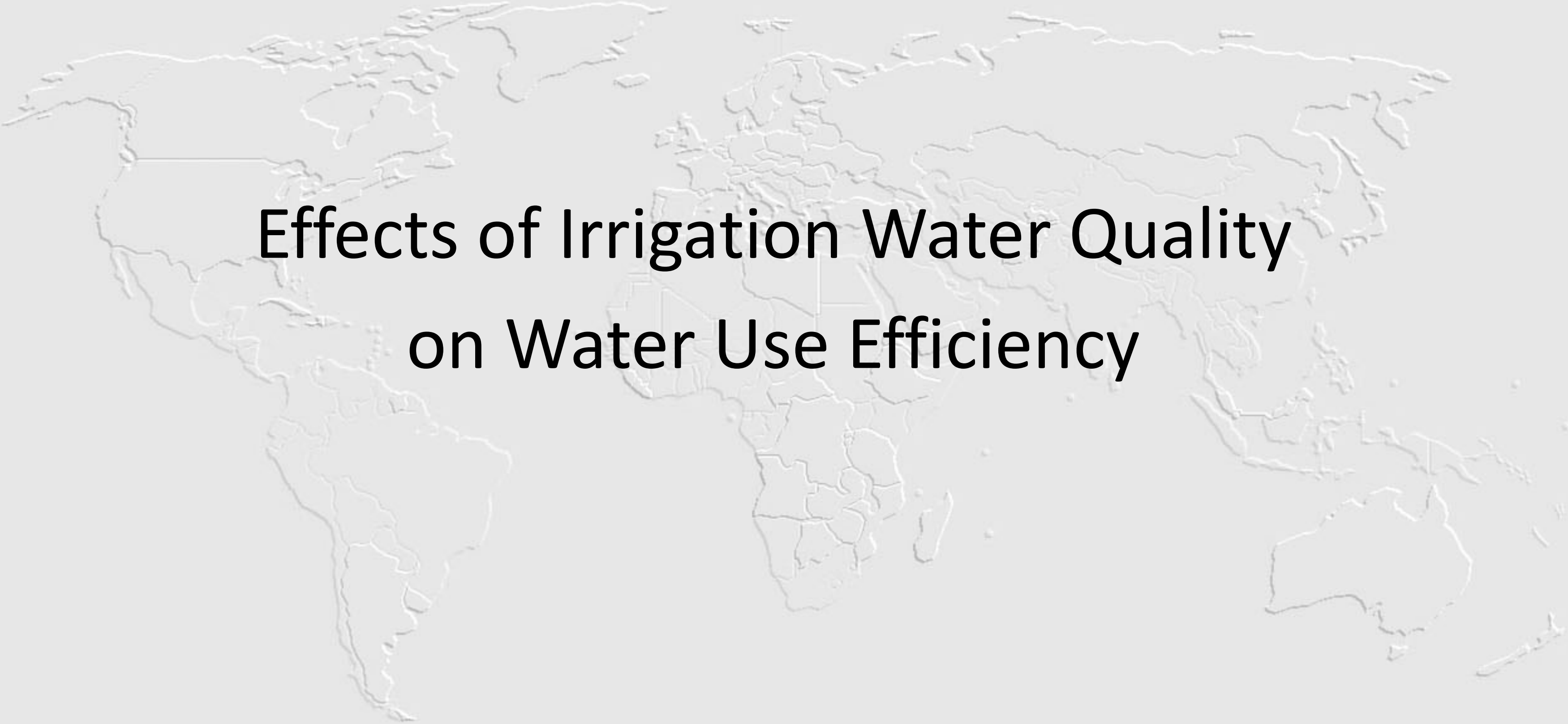
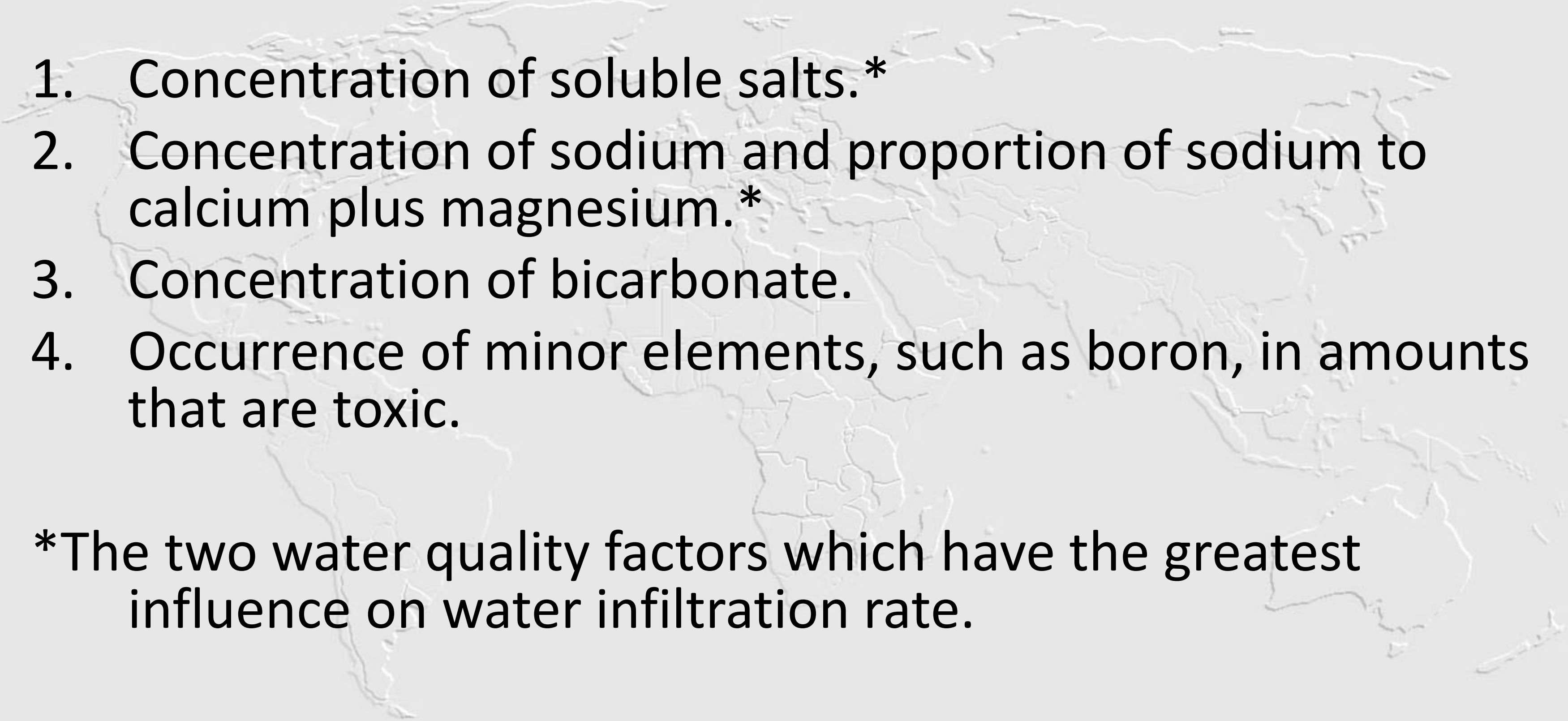


Effects of Irrigation Water Quality on Water Use Efficiency

Irrigation Water Quality Characteristics



1. Concentration of soluble salts.*
2. Concentration of sodium and proportion of sodium to calcium plus magnesium.*
3. Concentration of bicarbonate.
4. Occurrence of minor elements, such as boron, in amounts that are toxic.

*The two water quality factors which have the greatest influence on water infiltration rate.

Source: Ayers, R.S. and .Westcot. 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29, rev 1. Food and Agriculture Organization of the United Nations, Rome

Source: Fireman, Milton and H.E. Hayward. Irrigation Water and Saline and Alkali Soils *In* The Yearbook of Agriculture 1955. Department of Agriculture, Washington, D.C.

Salinity- the Concentration of Soluble Salts

- **Salts in irrigation water or soil reduce water availability to such an extent that yield is diminished**.
- Salt, or salinity, in irrigation water is composed of cations and anions so that the sum of the positive (+) and negative (-) charges is electrically neutral.
- *Total concentration of salts* = sum of cations and anions.
- *Important cations and anions in irrigation water*:
  - Cations: H+, Na^+, K^+, Ca^{2+}, Mg^{2+}
  - Anions: OH^-, HCO_3^-, CO_3^{2-}, SO_4^{2-}, Cl^-, NO_3^-, HBO_3^{2-}
- **Measurement of salinity**
  - Weight per unit volume (ppm, lbs/acre-foot).
  - Electrical equivalents per unit volume (meq/L, µeq/ml)
  - Electrical Conductivity (mmhos/cm, µmhos/cm, dS/m).
  - Osmotic Potential (bar, atm, kPa).

Sodium, Calcium & Magnesium – Important to Soil Structure, Health and Crop Yield

- **Sodium tends to disperse colloidal particles (<0.002 mm) in a soil**, resulting in:
  - impaired gas exchange (particularly O_2 and CO_2).
  - reduced infiltration rates of water and slower water movement in all directions in the soil.
  - Reduced rates of uptake of water, mineral nutrients and oxygen by plants.
  - Diminished rates of crop growth and diminished crop yield.
- **Calcium and magnesium tend to aggregate colloidal particles in a soil**, resulting in:
  - Creation of pore space.
  - Freer movement of gases in the soil.
  - Greater oxygen content of soil pores.
  - Increased aerobic microbial activity.
  - Increased rates of uptake of oxygen, water and mineral nutrients by plant roots.
  - Increased crop growth rates and yield.

Sodium Adsorption Ratio (SAR)

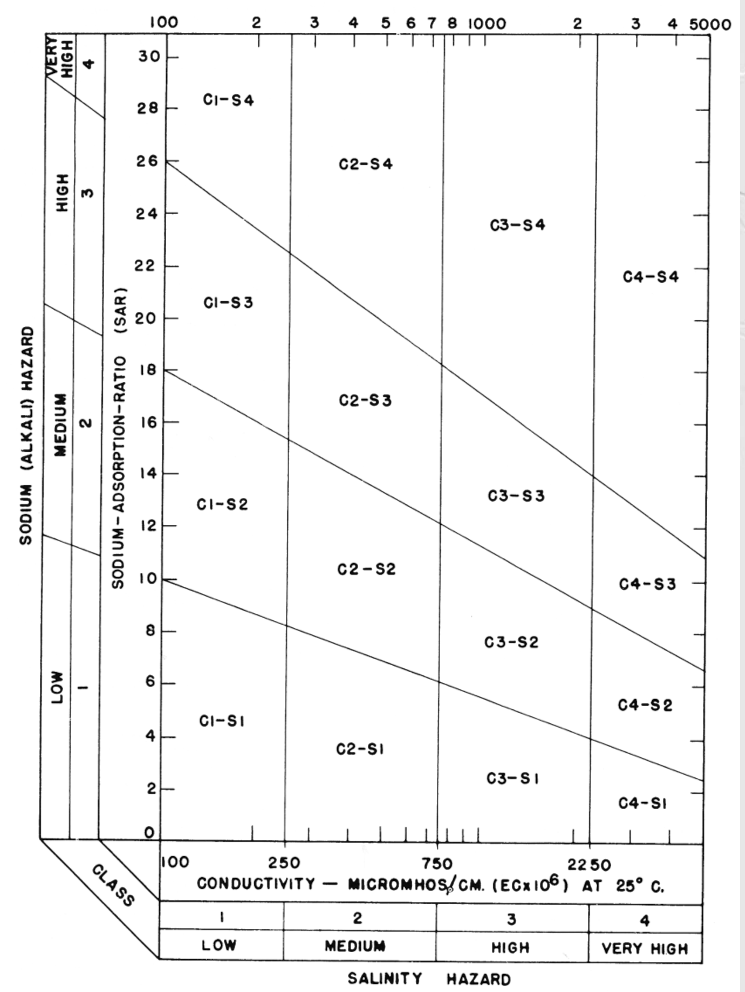
- Excessive Na in irrigation water (>3:1::Na:Ca)

- SAR is the most commonly used method to evaluate the infiltration rate problem.

- $\text{SAR} = \text{Na}^{+}/ \sqrt{\text{Ca}^{2+} + \text{Mg}^{2+})/2}$

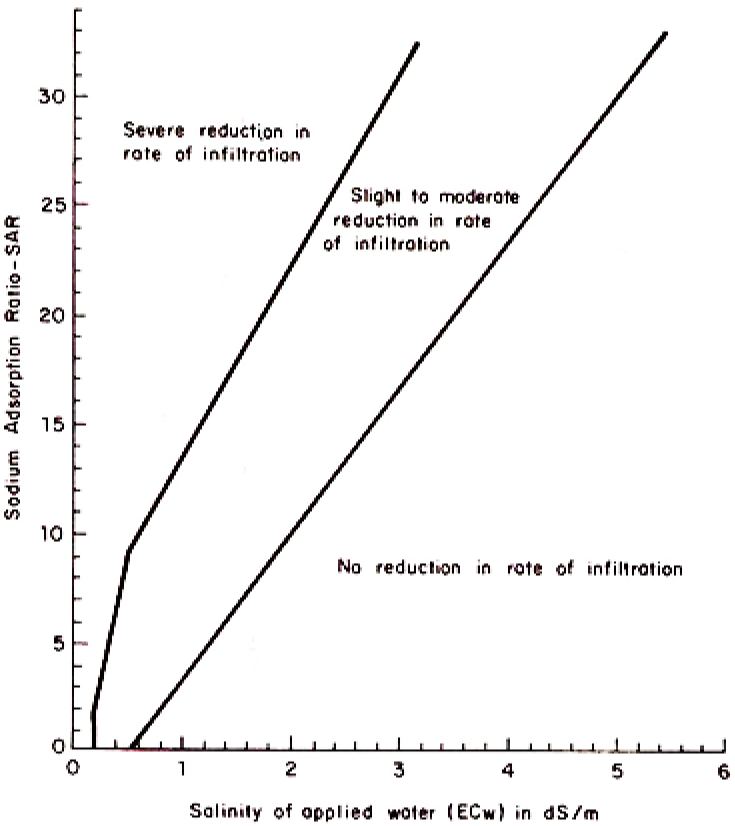
where Na^{+}, Ca^{2+} and Mg^{2+} represent the concentrations, in millequivalents per liter, of the respective ions.

Classification of Irrigation Waters Sodium (Alkali) and Salinity Hazards Based on Sodium Adsorption Ratio and Salinity



Source: United States Salinity Laboratory Staff. 1969. Diagnosis and Improvement of Saline and Alkali Soils. United States Department of Agriculture Handbook No. 60, Washington, DC

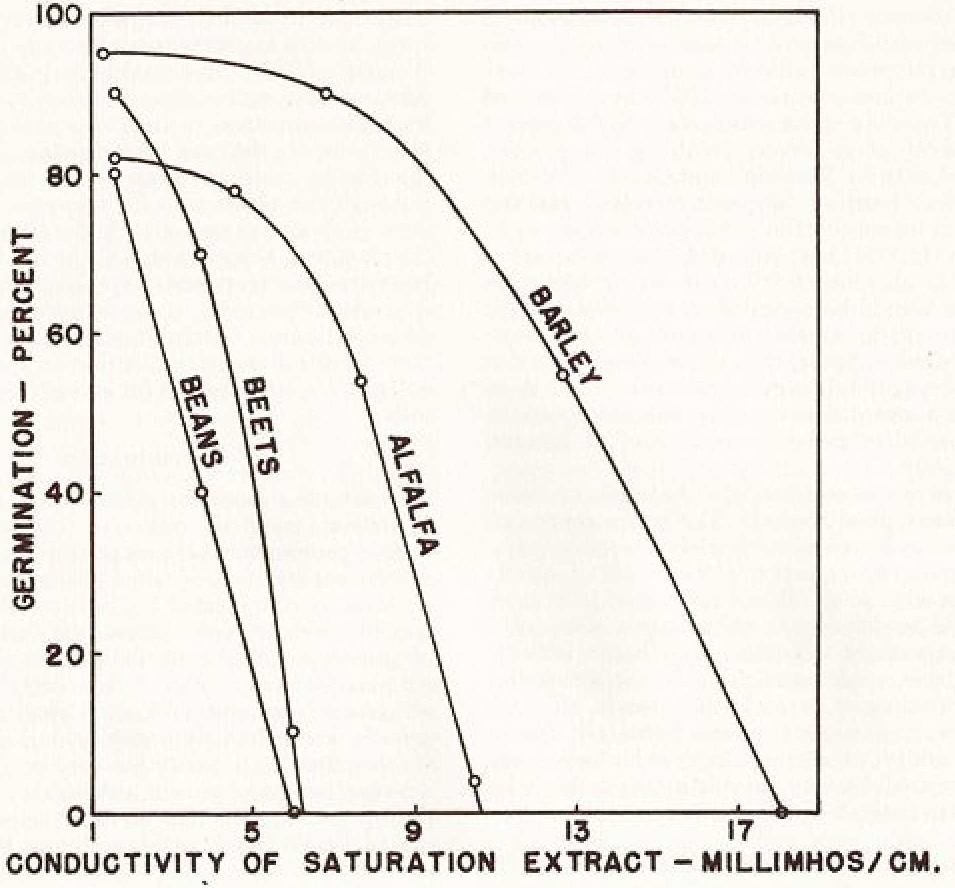
SAR and Salinity to Predict Infiltration Problems



Relative rate of water infiltration as affected by salinity and sodium adsorption ratio (Adapted from Rhoades 1977; and Oster and Schroer 1979)

Source: Ayers, R.S. and D.W. Westcot. 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29, rev 1. Food and Agriculture Organization of the United Nations, Rome

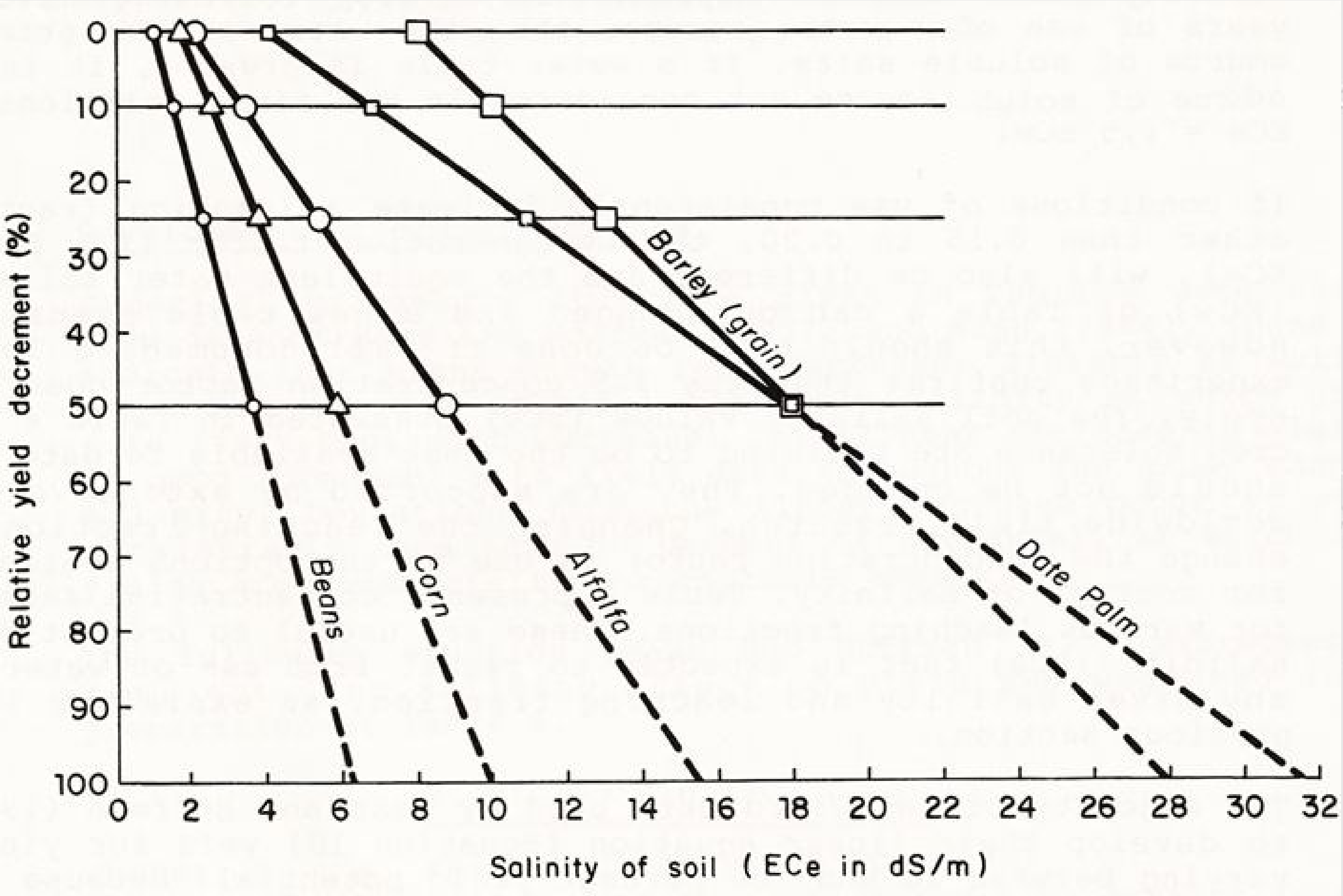
Germination & Soil Salinity



Percent germination of four crops, as related to the conductivity of the saturation extract of the soil, under laboratory conditions (Ayers and Hayward, 1949).

Source: United States Salinity Laboratory Staff. 1969. Diagnosis and Improvement of Saline and Alkali Soils. United States Department of Agriculture Handbook No. 60, Washington, DC

Crop Selection & Soil Salinity

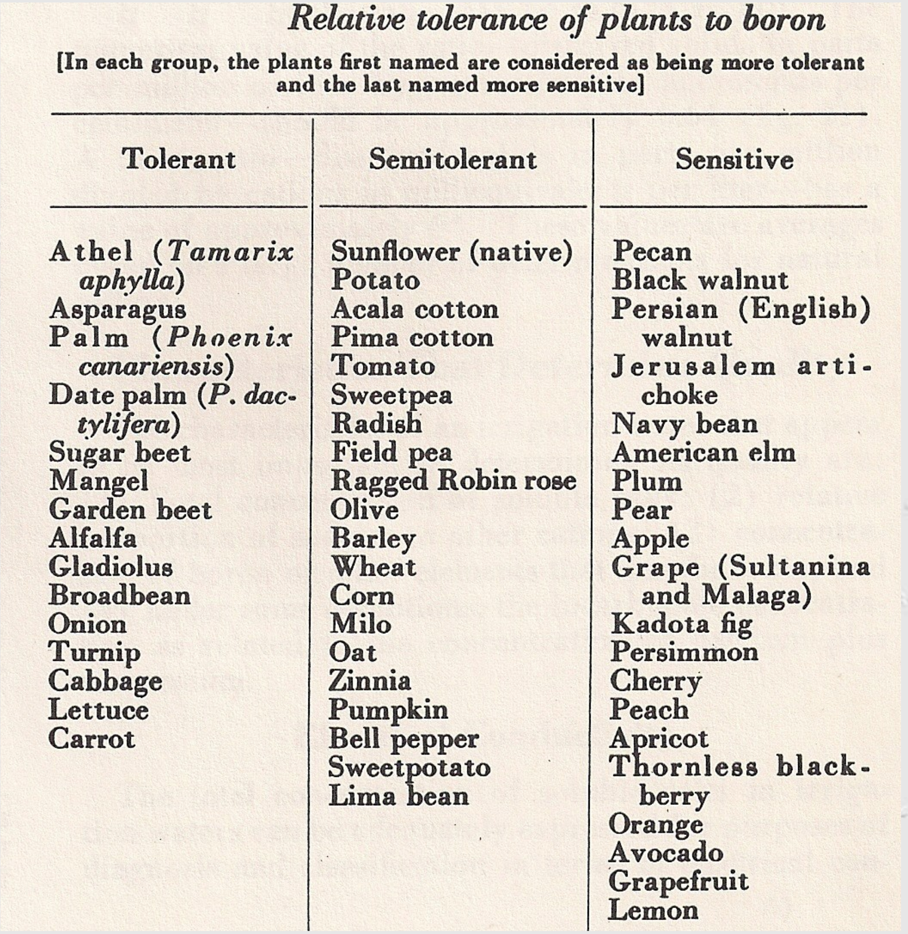


Bicarbonate

- Bicarbonate ions form as a result of the solution of carbon dioxide in water.
- CO_2 may be of atmospheric or biological origin.
- Relative proportions of carbonic acid, bicarbonate ions and carbonate ions depend upon pH of the water.
- **Carbonate from irrigation water or from bicarbonate can form calcium carbonate, or lime, that can clog soil pores.**
- In managing alkaline soils, it is important to reduce or eliminate bicarbonate and carbonate from irrigation water and from the soil solution.

Boron (B), an Essential, but Sometimes Toxic Element

- The principal source of B is the mineral, tourmaline, a widespread but minor constituent of primary rocks.
- Calcium borate can precipitate in alkaline soils, giving rise to boron deficiency.
- Boron exists as borate anions in the soil solution



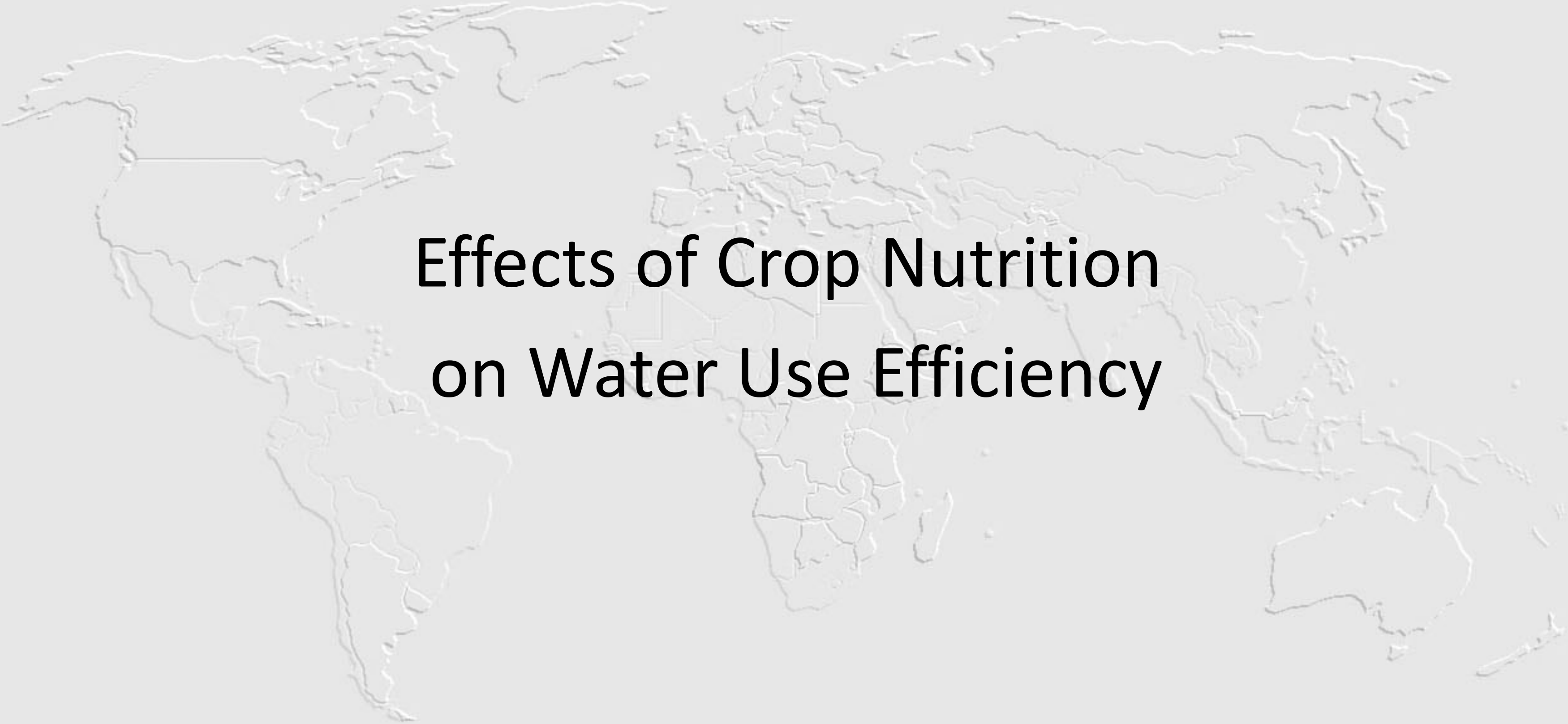
Relative tolerance of plants to boron

[In each group, the plants first named are considered as being more tolerant and the last named more sensitive]

Tolerant	Semitolerant	Sensitive
Athel (*Tamarix aphylla*)	Sunflower (native)	Pecan
Asparagus	Potato	Black walnut
Palm (*Phoenix canariensis*)	Acala cotton	Persian (English) walnut
Date palm (*P. dactylifera*)	Pima cotton	Jerusalem artichoke
Sugar beet	Tomato	Navy bean
Mangel	Sweetpea	American elm
Garden beet	Radish	Plum
Alfalfa	Field pea	Pear
Gladiolus	Ragged Robin rose	Apple
Broadbean	Olive	Grape (Sultanina and Malaga)
Onion	Barley	Kadota fig
Turnip	Wheat	Persimmon
Cabbage	Corn	Cherry
Lettuce	Milo	Peach
Carrot	Oat	Apricot
	Zinnia	Thornless blackberry
	Pumpkin	Orange
	Bell pepper	Avocado
	Sweetpotato	Grapefruit
	Lima bean	Lemon

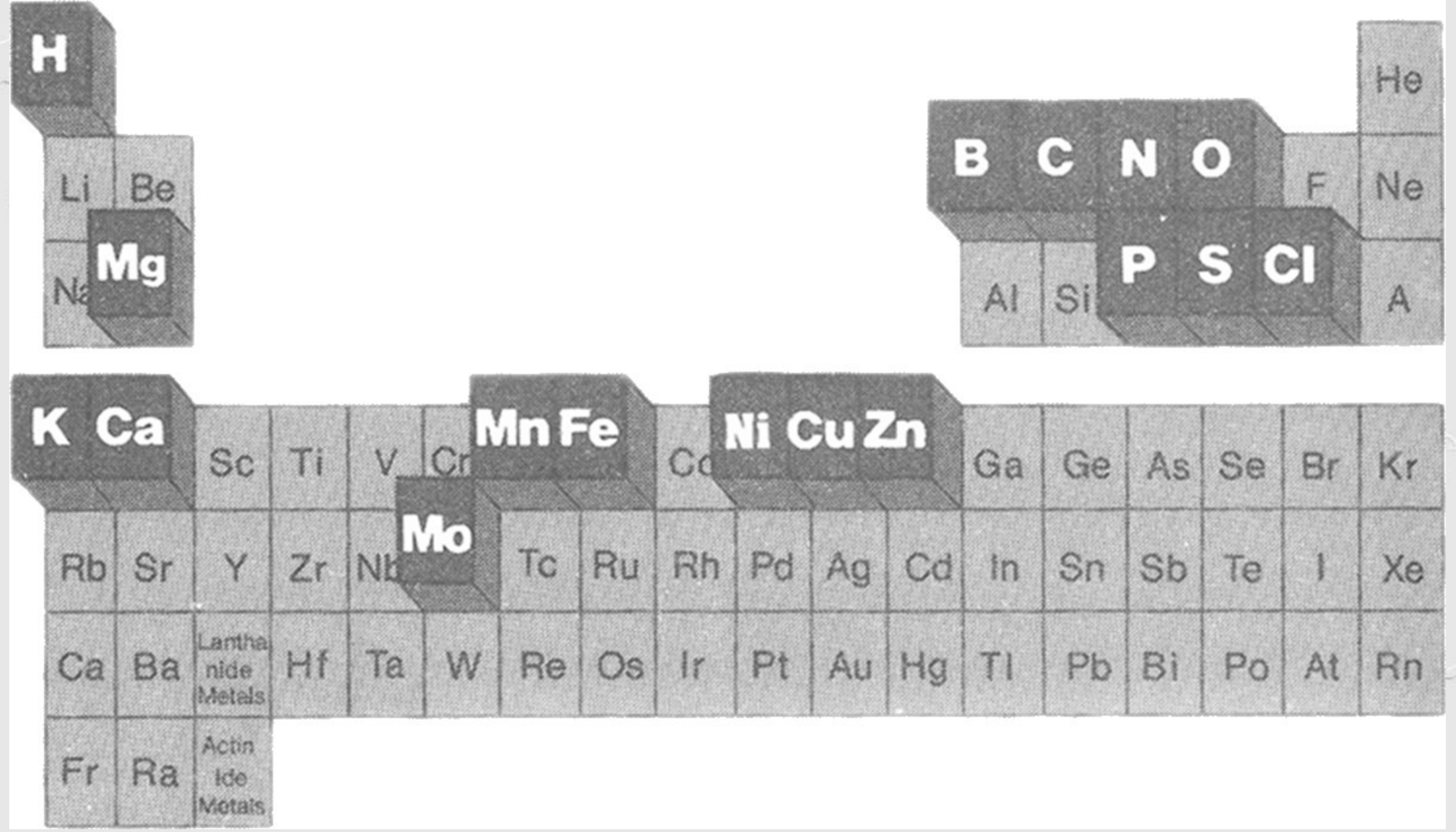
Permissible limits of boron for several classes of irrigation waters: <1.0 – >3.5 ppm |<0.67 – >2.5 ppm | <0.33 - > 1.25 ppm

Source: United States Salinity Laboratory Staff. 1969. Diagnosis and Improvement of Saline and Alkali Soils. United States Department of Agriculture Handbook No. 60, Washington, DC



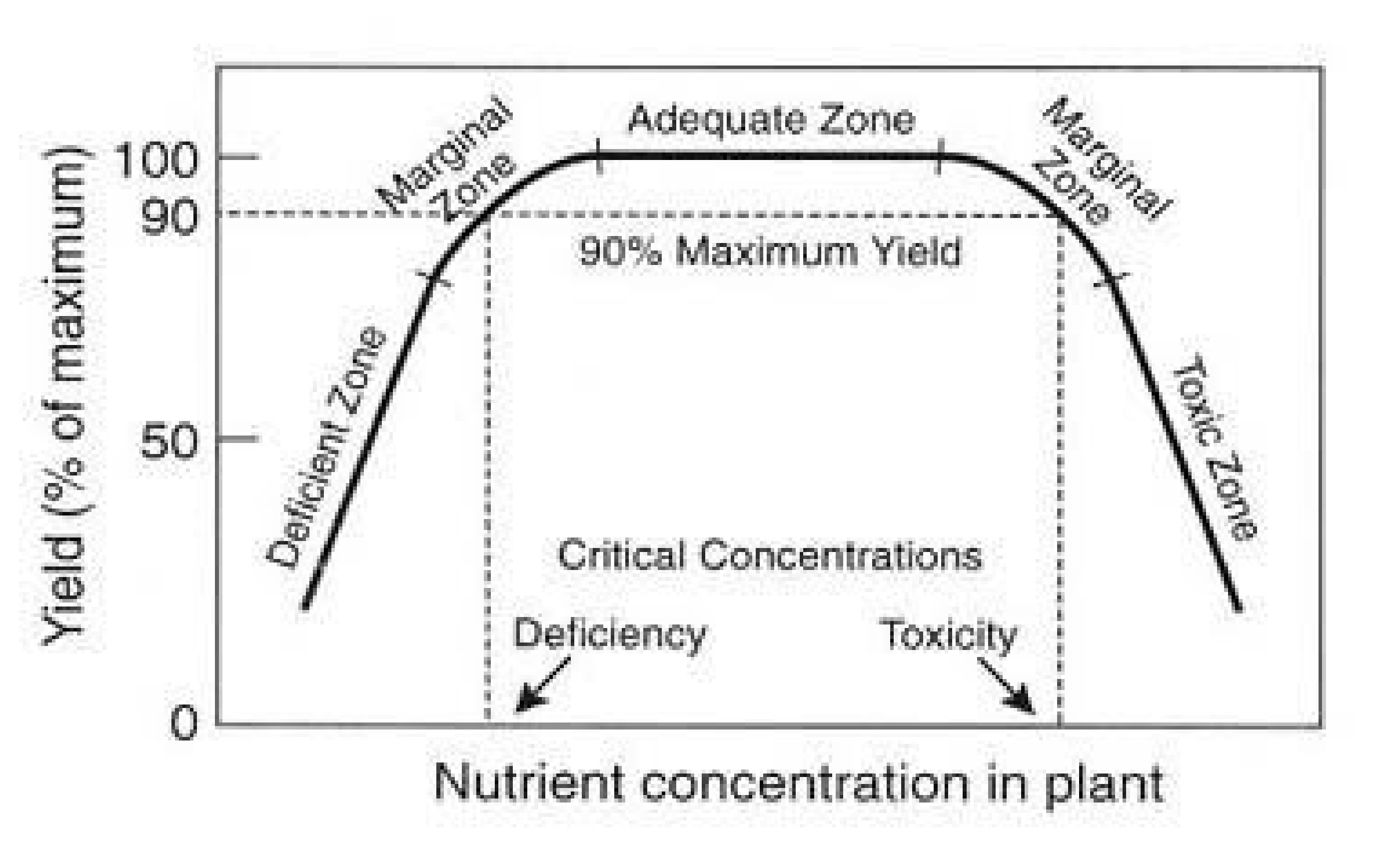
Effects of Crop Nutrition on Water Use Efficiency

The 17 Essential Plant Nutrients in the Periodic Table of the Elements



Source: Western Fertilizer Handbook, Seventh Edition

Concentrations of the 17 Essential Plant Nutrients for Maximum Yield

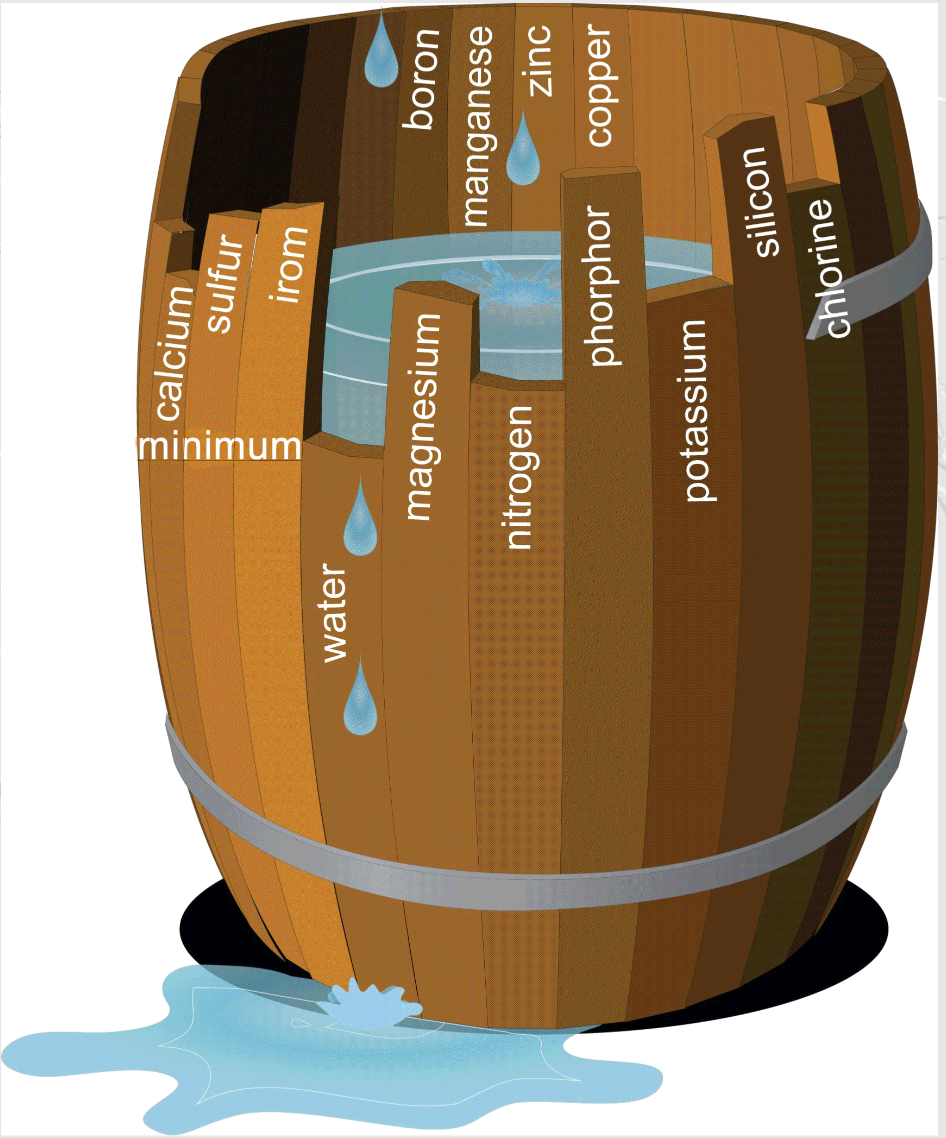


Sprengel-Liebig “Law of the Minimum”

- Theory of Kurt Sprengel (March 29, 1787 – April 19, 1859) popularized by Justus von Liebig (May 12, 1803 – April 18, 1873)
- Sprengel’s “Theory of the minimum”
- *Plant growth is limited by the essential nutrient at the lowest concentration.*
- *Growth is controlled not by the total amount of resources available, but by the scarcest resource, or limiting factor.*

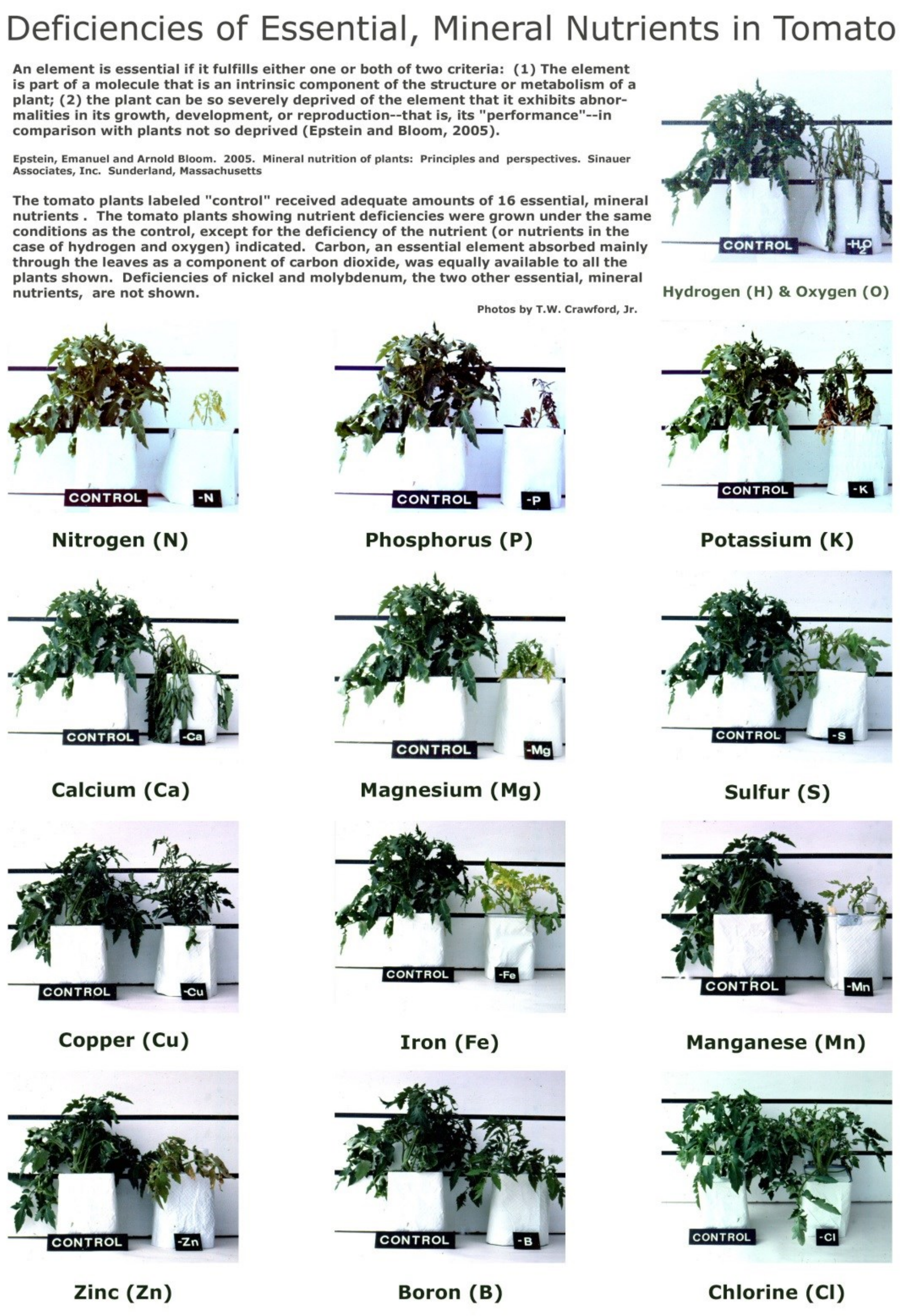
Source: R. R. van der Ploeg,* W. Bo¨ hm, and M. B. Kirkham. 1999. On the Origin of the Theory of Mineral Nutrition of Plants and the Law of the Minimum. Soil Science Society of America Journal 63:1055–1062.

Law of the Minimum



Reduction of Water Use Efficiency Due to Deficiency of Essential Plant Nutrients

Deficiencies of all plant nutrients reduce water use efficiency (WUE), because all nutrient deficiencies reduce the rates of metabolic processes, all of which are in some way connected to photosynthesis that assimilates atmospheric carbon from carbon dioxide and splits water molecules for assimilation of hydrogen and oxygen.



Deficiencies of Essential, Mineral Nutrients in Tomato

An element is essential if it fulfills either one or both of two criteria: (1) The element is part of a molecule that is an intrinsic component of the structure or metabolism of a plant; (2) the plant can be so severely deprived of the element that it exhibits abnormalities in its growth, development, or reproduction--that is, its "performance"--in comparison with plants not so deprived (Epstein and Bloom, 2005).

Epstein, Emanuel and Arnold Bloom. 2005. Mineral nutrition of plants: Principles and perspectives. Sinauer Associates, Inc. Sunderland, Massachusetts

The tomato plants labeled "control" received adequate amounts of 16 essential, mineral nutrients . The tomato plants showing nutrient deficiencies were grown under the same conditions as the control, except for the deficiency of the nutrient (or nutrients in the case of hydrogen and oxygen) indicated. Carbon, an essential element absorbed mainly through the leaves as a component of carbon dioxide, was equally available to all the plants shown. Deficiencies of nickel and molybdenum, the two other essential, mineral nutrients, are not shown.

Photos by T.W. Crawford, Jr.

Hydrogen (H) & Oxygen (O)

Nitrogen (N)

Phosphorus (P)

Potassium (K)

Calcium (Ca)

Magnesium (Mg)

Sulfur (S)

Copper (Cu)

Iron (Fe)

Manganese (Mn)

Zinc (Zn)

Boron (B)

Chlorine (Cl)

Hydrogen & Oxygen (Water) Deficiency

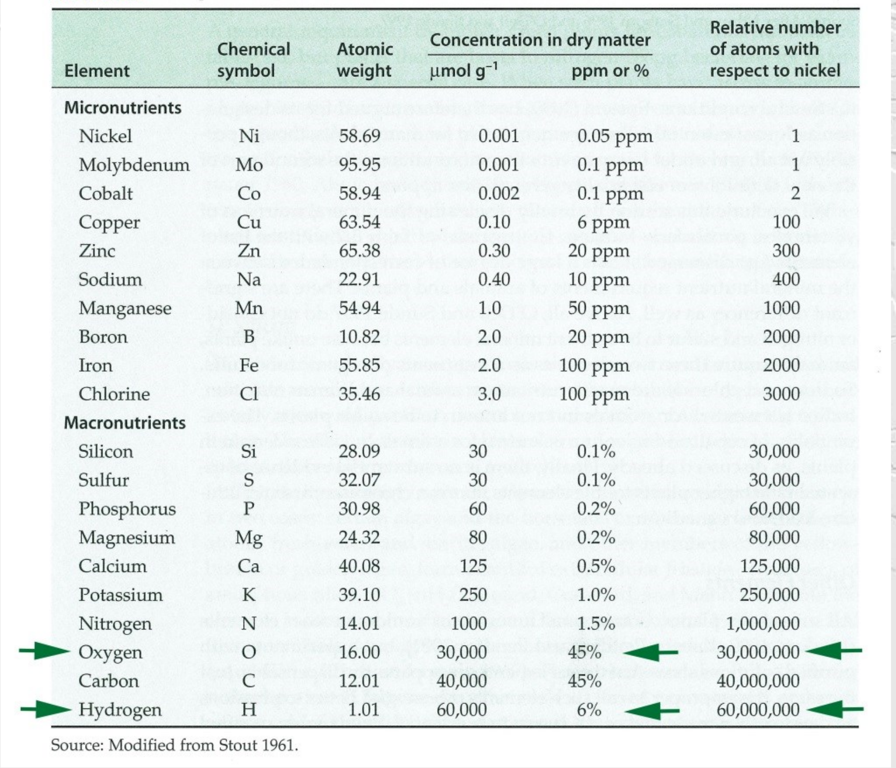


TABLE 3.3 **Adequate Concentrations of Elements in Plant Tissue**

Element	Chemical symbol	Atomic weight	Concentration in dry matter		Relative number of atoms with respect to nickel
			μmol g^{-1}	ppm or %	
Micronutrients					
Nickel	Ni	58.69	0.001	0.05 ppm	1
Molybdenum	Mo	95.95	0.001	0.1 ppm	1
Cobalt	Co	58.94	0.002	0.1 ppm	2
Copper	Cu	63.54	0.10	6 ppm	100
Zinc	Zn	65.38	0.30	20 ppm	300
Sodium	Na	22.91	0.40	10 ppm	400
Manganese	Mn	54.94	1.0	50 ppm	1000
Boron	B	10.82	2.0	20 ppm	2000
Iron	Fe	55.85	2.0	100 ppm	2000
Chlorine	Cl	35.46	3.0	100 ppm	3000
Macronutrients					
Silicon	Si	28.09	30	0.1%	30,000
Sulfur	S	32.07	30	0.1%	30,000
Phosphorus	P	30.98	60	0.2%	60,000
Magnesium	Mg	24.32	80	0.2%	80,000
Calcium	Ca	40.08	125	0.5%	125,000
Potassium	K	39.10	250	1.0%	250,000
Nitrogen	N	14.01	1000	1.5%	1,000,000
Oxygen	O	16.00	30,000	45%	30,000,000
Carbon	C	12.01	40,000	45%	40,000,000
Hydrogen	H	1.01	60,000	6%	60,000,000

Source: Modified from Stout 1961.

Source: Emanuel Epstein and Arnold J. Bloom. 2005. Mineral Nutrition of Plants: Principles and Perspectives. Second Edition. Sinauer Associates, Inc. Sunderland, Massachusetts

Water Deficiency in the Sahel

A climatic deficit of H and O (H_2O) . . .

FIGURE 1. Average monthly potential evapotranspiration (ETP) and rainfall at Konni and Maradi from 1980-1997.

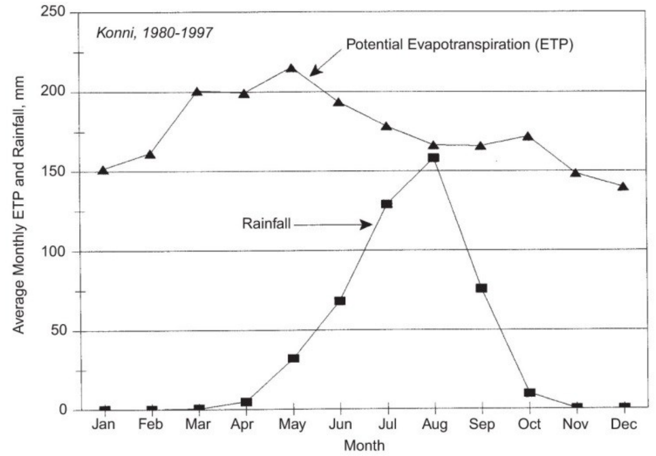
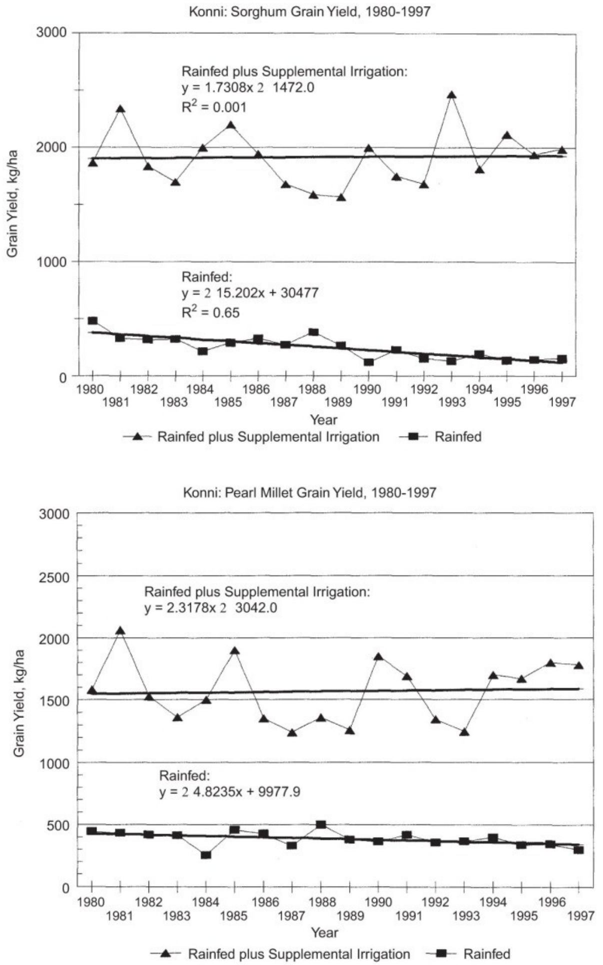


FIGURE 2. Trends in grain yields of pearl millet and sorghum under conditions of rainfall and rainfall plus supplementary irrigation at Konni, 1980-1997.



Yields of irrigated sorghum and millet have historically been 3X to 4X higher than rainfed yields in the Konni area of Niger. . .

Pandey, R. K. , Crawford Jr., T. W. and Maranville, J. W. 2002. Agriculture Intensification and Ecologically Sustainable Land Use in Niger: A Case Study of Evolution of Intensive Systems with Supplementary Irrigation. Journal of Sustainable Agriculture, 20: 3, 33 — 55

Drip Irrigation and Soil Sampling for Plant Nutrients in Afghanistan

Nitrogen Deficiency

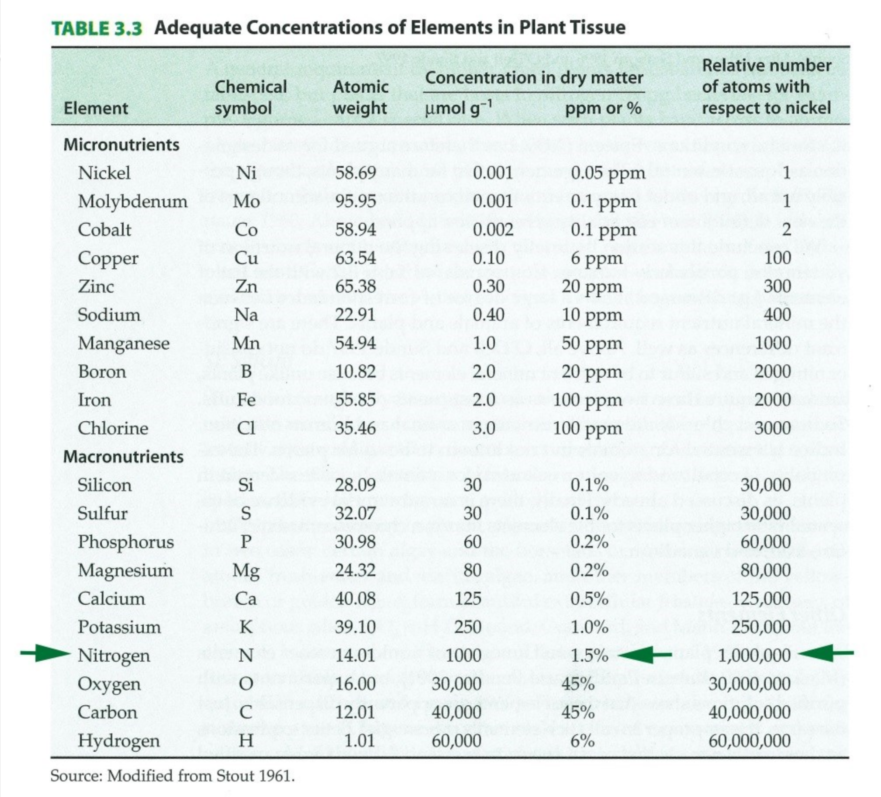
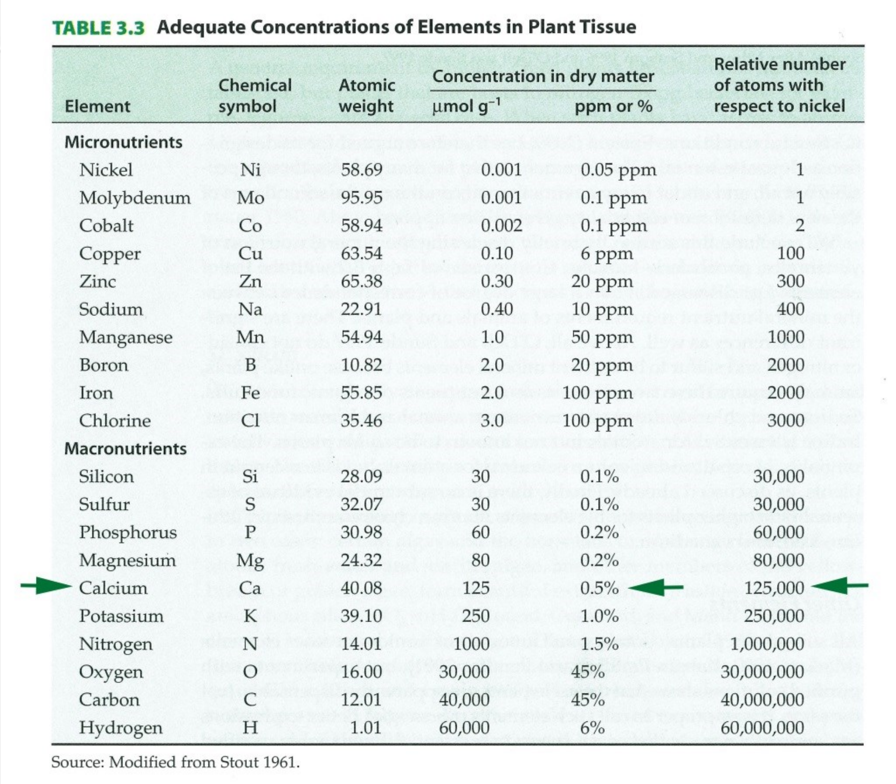


TABLE 3.3 Adequate Concentrations of Elements in Plant Tissue

Element	Chemical symbol	Atomic weight	Concentration in dry matter		Relative number of atoms with respect to nickel
			μmol g^{-1}	ppm or %	
Micronutrients					
Nickel	Ni	58.69	0.001	0.05 ppm	1
Molybdenum	Mo	95.95	0.001	0.1 ppm	1
Cobalt	Co	58.94	0.002	0.1 ppm	2
Copper	Cu	63.54	0.10	6 ppm	100
Zinc	Zn	65.38	0.30	20 ppm	300
Sodium	Na	22.91	0.40	10 ppm	400
Manganese	Mn	54.94	1.0	50 ppm	1000
Boron	B	10.82	2.0	20 ppm	2000
Iron	Fe	55.85	2.0	100 ppm	2000
Chlorine	Cl	35.46	3.0	100 ppm	3000
Macronutrients					
Silicon	Si	28.09	30	0.1%	30,000
Sulfur	S	32.07	30	0.1%	30,000
Phosphorus	P	30.98	60	0.2%	60,000
Magnesium	Mg	24.32	80	0.2%	80,000
Calcium	Ca	40.08	125	0.5%	125,000
Potassium	K	39.10	250	1.0%	250,000
Nitrogen	N	14.01	1000	1.5%	1,000,000
Oxygen	O	16.00	30,000	45%	30,000,000
Carbon	C	12.01	40,000	45%	40,000,000
Hydrogen	H	1.01	60,000	6%	60,000,000

Source: Modified from Stout 1961.

Calcium Deficiency



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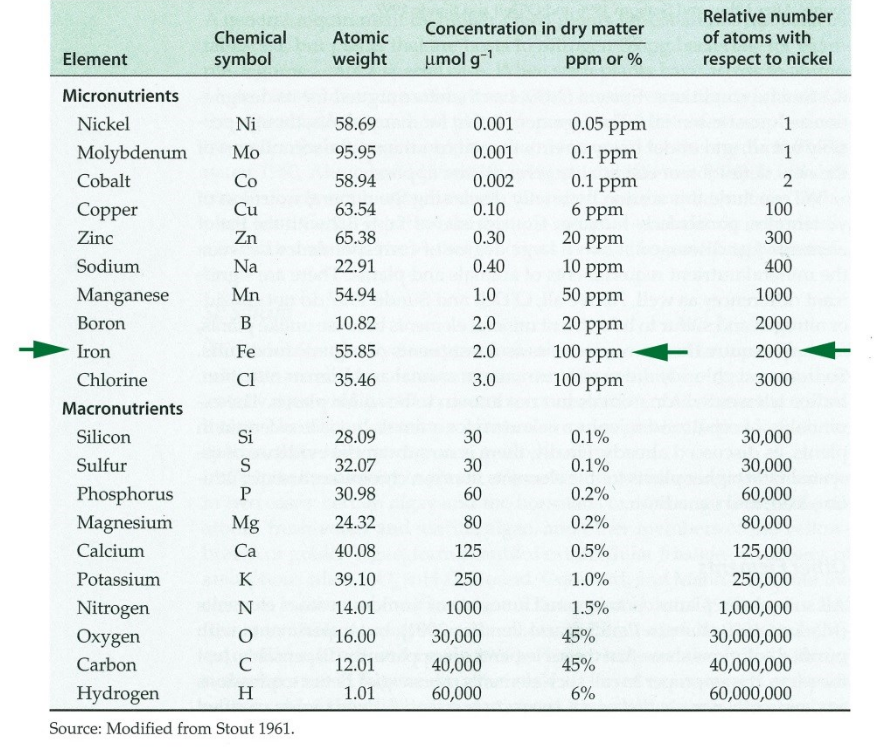
Source: Modified from Stout 1961.

Source: Emanuel Epstein and Arnold J. Bloom. 2005. Mineral Nutrition of Plants: Principles and Perspectives. Second Edition. Sinauer Associates, Inc. Sunderland, Massachusetts

Iron Deficiency



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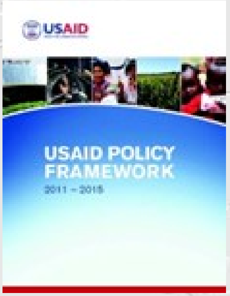
USAID Promotes Scientific Innovation

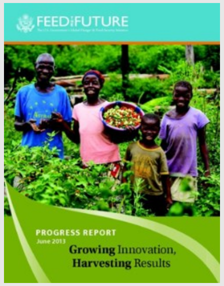


USAID

USAID POLICY FRAMEWORK

2011 – 2015

- “Science, technology, and innovation can produce particularly powerful outcomes when complemented by other investments.”



FEED THE FUTURE

PROGRESS REPORT

June 2013

Growing Innovation, Harvesting Results

- “Scientific innovation and technology are critical to meeting the global challenges of producing more food with less **land** and **water** and helping farmers adapt to climatic, social and economic shocks.”

Micro Carbon Technology®

An Innovative Technology of Bio Huma Netics, Inc. (BHN) for Fertilizers, Pesticides and Wastewater Treatment Products

Scientifically Engineered Technology

- Micro Carbon Technology®
  - Symbol
    - Carbon Ring (leonardite / carbon source)
      - Soil
      - Plants
      - Water

The Origins of Micro Carbon Technology®

- In 1973 scientists of Sunburst Mining Co., the predecessor of Bio Huma Netics, Inc., discovered a unique material in a company owned mine located in the state of Idaho.

- When applied to farmers' fields, this material improved both the soil's fertility and the plants' nutrient uptake.

- This material is mainly composed of leonardite, an oxygen-rich form of soft coal that is made up of decomposed plant matter and minerals.

Micro Carbon Technology®
An Innovative Fertilizer Technology

- Proprietary Extraction Process
  - A proprietary, time-tested biological & chemical extraction process.
  - Decomposes humic substances of leonardite.
  - Produces a mixture of organic molecules, many of which are small and more chemically active.

From Leonardite to Micro Carbon Technology®

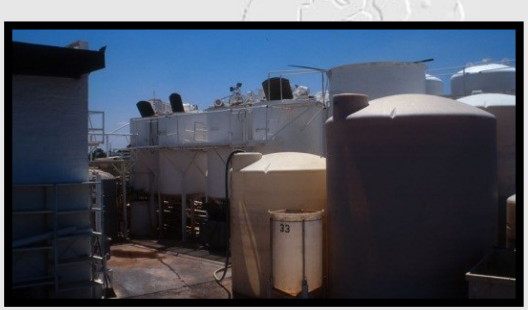
Leonardite Mine

Leonardite Delivered to BHN

Biological Digestion

(The process is a trade secret)

Chemical Extraction



Complexing with Nutrients

HUMA GRO **products**

Probiotic SOLUTIONS® **products**

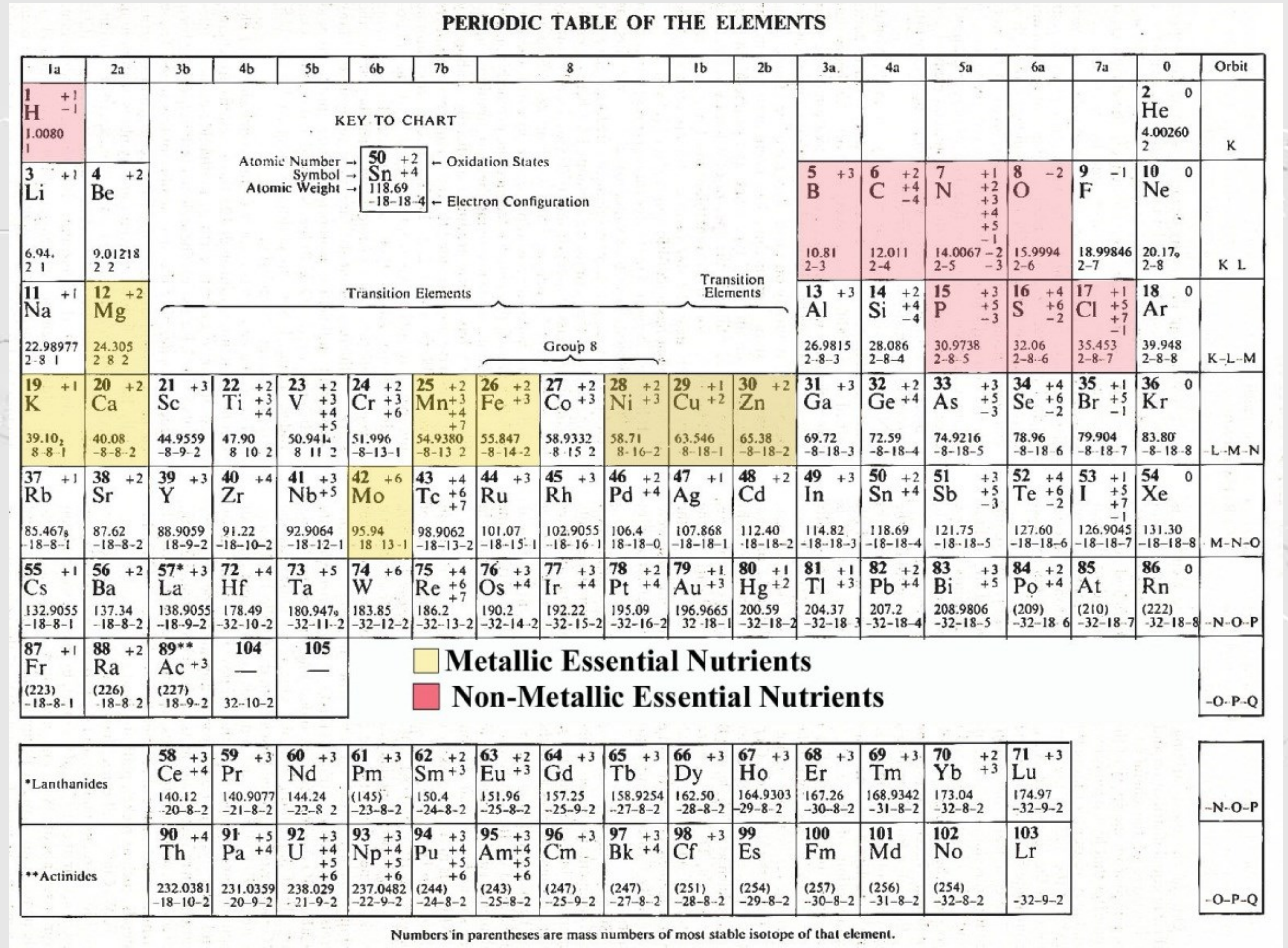
Functional Groups of Humic and Fulvic Acids that Contain Oxygen

	Total Cation Exchange Capacity	-COOH	Acid -OH	Weakly Acid and Alcolholic -OH	-C=O
	Normal Range, cmol(+) per kg				
Humic Acids	500-870	150-300	250-570	270-350	90-300
Fulvic Acids	900-1,400	610-910	270-670	330-490	110-310

Source: F. J. Stevenson and J. H. A. Butler. 1969. Chemistry of humic acids and related pigments. P. 534-577. In G. Englinton and Sister M. T. J. Murphy (eds.). Organic geochemistry. Springer-Verlag, Berlin.

Micro Carbon Technology® produces organic (carbon-containing) molecules more chemically active than humic and fulvic acids

The 17 Essential Plant Nutrients



PERIODIC TABLE OF THE ELEMENTS

KEY TO CHART

Atomic Number → 50 +2 ← Oxidation States
Symbol → Sn +4
Atomic Weight → 118.69
-18-18-4 ← Electron Configuration

Transition Elements
Transition Elements
Group 8

1a	2a	3b	4b	5b	6b	7b	8			1b	2b	3a	4a	5a	6a	7a	0	Orbit
🟥 1 +1 -1 H 1.0080 1																	2 0 He 4.00260 2	K
3 +1 Li 6.94, 2-1	4 +2 Be 9.01218 2-2											🟥 5 +3 B 10.81 2-3	🟥 6 +2 +4 -4 C 12.011 2-4	🟥 7 +1 +2 +3 +4 +5 -1 -2 -3 N 14.0067 2-5	🟥 8 -2 O 15.9994 2-6	9 -1 F 18.99846 2-7	10 0 Ne 20.17$_9$ 2-8	K L
11 +1 Na 22.98977 2-8-1	🟨 12 +2 Mg 24.305 2-8-2											13 +3 Al 26.9815 2-8-3	14 +2 +4 -4 Si 28.086 2-8-4	🟥 15 +3 +5 -3 P 30.9738 2-8-5	🟥 16 +4 +6 -2 S 32.06 2-8-6	🟥 17 +1 +5 +7 -1 Cl 35.453 2-8-7	18 0 Ar 39.948 2-8-8	K-L-M
🟨 19 +1 K 39.10$_2$ 8-8-1	🟨 20 +2 Ca 40.08 -8-8-2	21 +3 Sc 44.9559 -8-9-2	22 +2 +3 +4 Ti 47.90 8-10-2	23 +2 +3 +4 +5 V 50.94$_{14}$ 8-11-2	24 +2 +3 +6 Cr 51.996 -8-13-1	🟨 25 +2 +3 +4 +7 Mn 54.9380 -8-13-2	🟨 26 +2 +3 Fe 55.847 -8-14-2	27 +2 +3 Co 58.9332 -8-15-2	🟨 28 +2 +3 Ni 58.71 8-16-2	🟨 29 +1 +2 Cu 63.546 8-18-1	🟨 30 +2 Zn 65.38 -8-18-2	31 +3 Ga 69.72 -8-18-3	32 +2 +4 Ge 72.59 -8-18-4	33 +3 +5 -3 As 74.9216 -8-18-5	34 +4 +6 -2 Se 78.96 -8-18-6	35 +1 +5 -1 Br 79.904 -8-18-7	36 0 Kr 83.80 -8-18-8	-L-M-N
37 +1 Rb 85.467$_8$ -18-8-1	38 +2 Sr 87.62 -18-8-2	39 +3 Y 88.9059 18-9-2	40 +4 Zr 91.22 -18-10-2	41 +3 +5 Nb 92.9064 -18-12-1	🟨 42 +6 Mo 95.94 18-13-1	43 +4 +6 +7 Tc 98.9062 -18-13-2	44 +3 Ru 101.07 -18-15-1	45 +3 Rh 102.9055 -18-16-1	46 +2 +4 Pd 106.4 18-18-0	47 +1 Ag 107.868 -18-18-1	48 +2 Cd 112.40 -18-18-2	49 +3 In 114.82 -18-18-3	50 +2 +4 Sn 118.69 -18-18-4	51 +3 +5 -3 Sb 121.75 -18-18-5	52 +4 +6 -2 Te 127.60 -18-18-6	53 +1 +5 +7 -1 I 126.9045 -18-18-7	54 0 Xe 131.30 -18-18-8	M-N-O
55 +1 Cs 132.9055 -18-8-1	56 +2 Ba 137.34 -18-8-2	57* +3 La 138.9055 -18-9-2	72 +4 Hf 178.49 -32-10-2	73 +5 Ta 180.947$_9$ -32-11-2	74 +6 W 183.85 -32-12-2	75 +4 +6 +7 Re 186.2 -32-13-2	76 +3 +4 Os 190.2 -32-14-2	77 +3 +4 Ir 192.22 -32-15-2	78 +2 +4 Pt 195.09 -32-16-2	79 +1 +3 Au 196.9665 32-18-1	80 +1 +2 Hg 200.59 -32-18-2	81 +1 +3 Tl 204.37 -32-18-3	82 +2 +4 Pb 207.2 -32-18-4	83 +3 +5 Bi 208.9806 -32-18-5	84 +2 +4 Po (209) -32-18-6	85 At (210) -32-18-7	86 0 Rn (222) -32-18-8	-N-O-P
87 +1 Fr (223) -18-8-1	88 +2 Ra (226) -18-8-2	89** +3 Ac (227) -18-9-2	104 — 32-10-2	105 —														-O-P-Q

🟨 **Metallic Essential Nutrients**

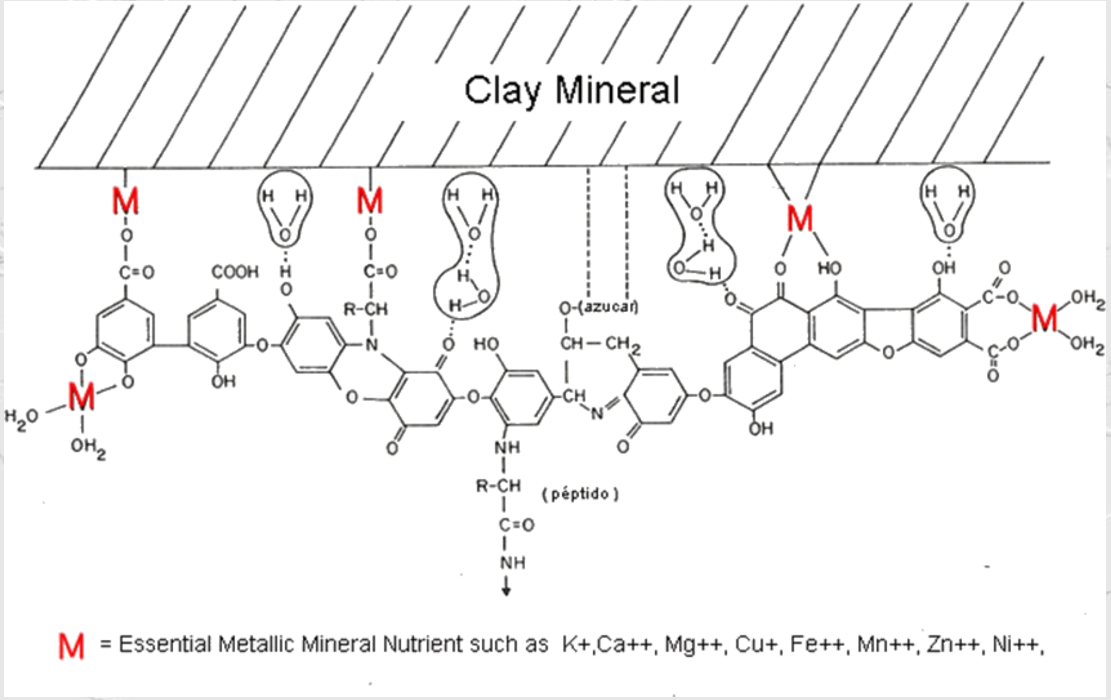
🟥 **Non-Metallic Essential Nutrients**

*Lanthanides	58 +3 +4 Ce 140.12 -20-8-2	59 +3 Pr 140.9077 -21-8-2	60 +3 Nd 144.24 -22-8-2	61 +3 Pm (145) -23-8-2	62 +2 +3 Sm 150.4 -24-8-2	63 +2 +3 Eu 151.96 -25-8-2	64 +3 Gd 157.25 -25-9-2	65 +3 Tb 158.9254 -27-8-2	66 +3 Dy 162.50 -28-8-2	67 +3 Ho 164.9303 -29-8-2	68 +3 Er 167.26 -30-8-2	69 +3 Tm 168.9342 -31-8-2	70 +2 +3 Yb 173.04 -32-8-2	71 +3 Lu 174.97 -32-9-2	-N-O-P
**Actinides	90 +4 Th 232.0381 -18-10-2	91 +5 +4 Pa 231.0359 -20-9-2	92 +3 +4 +5 +6 U 238.029 -21-9-2	93 +3 +4 +5 +6 Np 237.0482 -22-9-2	94 +3 +4 +5 +6 Pu (244) -24-8-2	95 +3 +4 +5 +6 Am (243) -25-8-2	96 +3 Cm (247) -25-9-2	97 +3 +4 Bk (247) -27-8-2	98 +3 Cf (251) -28-8-2	99 Es (254) -29-8-2	100 Fm (257) -30-8-2	101 Md (256) -31-8-2	102 No (254) -32-8-2	103 Lr -32-9-2	-O-P-Q

Numbers in parentheses are mass numbers of most stable isotope of that element.

Sources: Handbook of Chemistry and Physics, 54th ed. and Epstein and Bloom, 2005

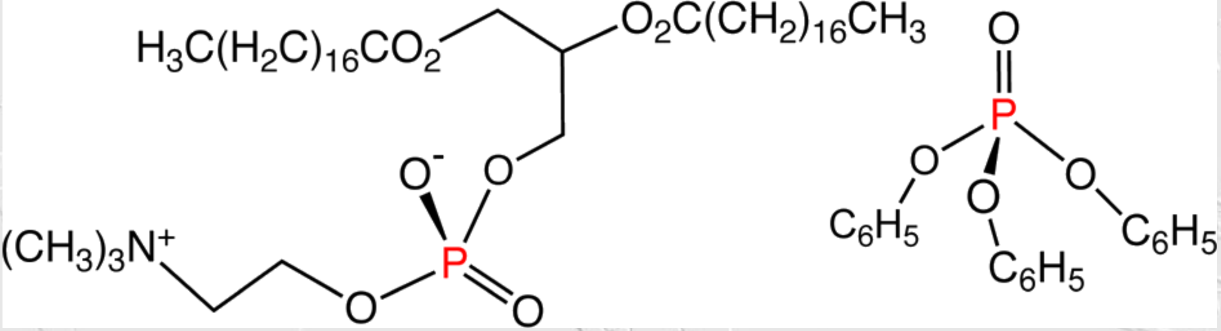
Clay-Metal-Organic Matter Complexes in Soil



M = Essential Metallic Mineral Nutrient such as K+,Ca++, Mg++, Cu+, Fe++, Mn++, Zn++, Ni++,

Source: FJ Stevenson and MS Ardakani. 1972. Organic Matter Reactions Involving Micronutrients in Soils. *In* JJ Mordtvedt, PM Giordano and WL Lindsay (eds.) Micronutrients in Agriculture. Soil Science Society of America, Madison, Wisconsin.

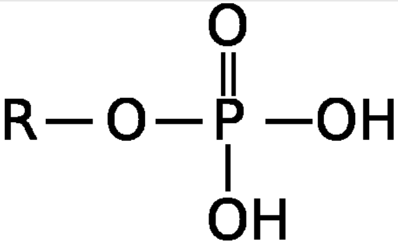
Examples of the Interaction of Phosphate with Organic (Carbon-containing) Substances



(Tertiary amine)

(Phenyl groups)

Phosphate esters*



$$R-O-\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle OH}{|}}{P}}-OH$$

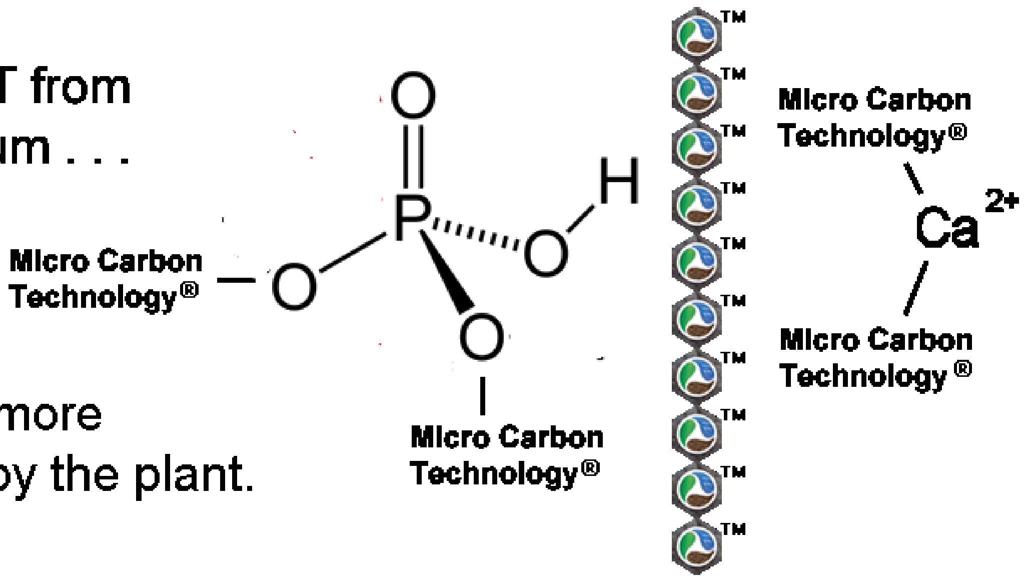
*An ester is formed by condensation of an acid with an alcohol.

Increased availability of phosphorus from Super Phos™ in comparison with fertilizers of conventional phosphoric acid.

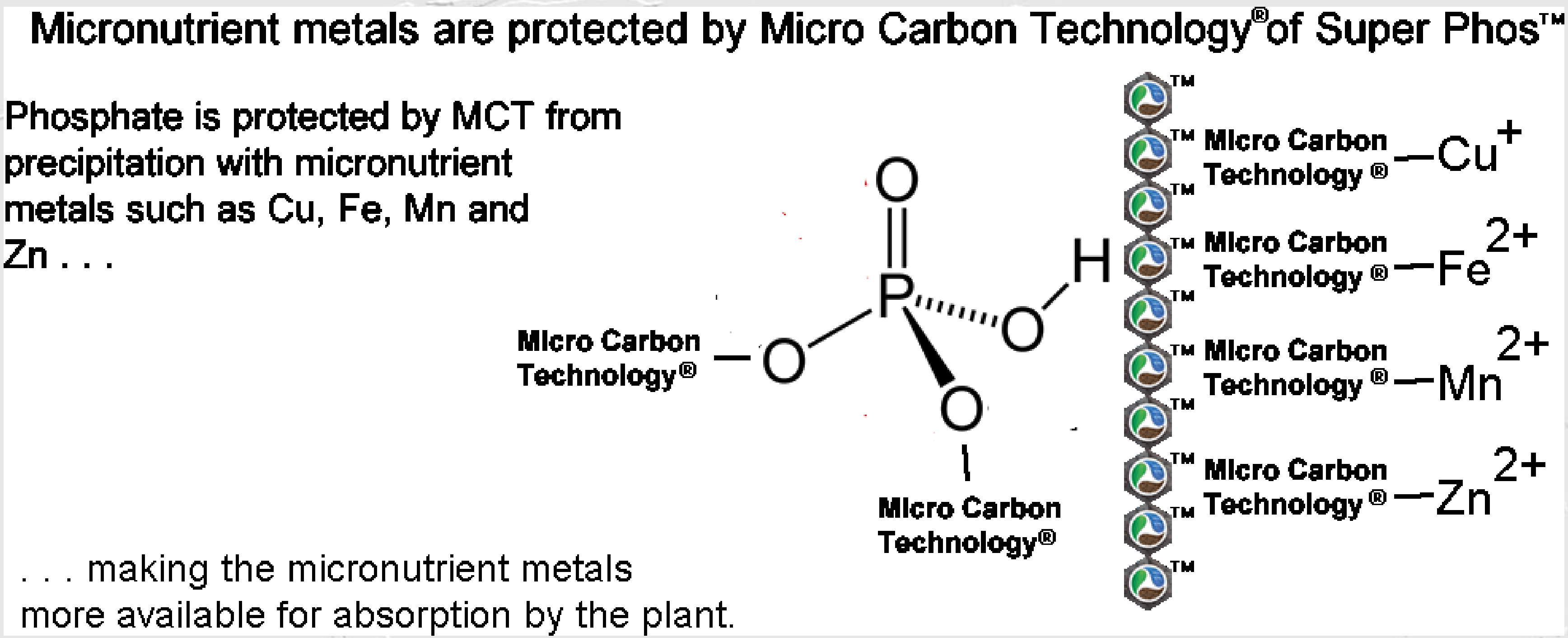
Phosphoric acid protected by Micro Carbon Technology® of Super Phos™

. . . is protected by MCT from precipitation with calcium . . .

. . . making phosphorus more available for absorption by the plant.



Increased availability of micronutrient metals from Super Phos™



Micronutrient metals are protected by Micro Carbon Technology® of Super Phos™

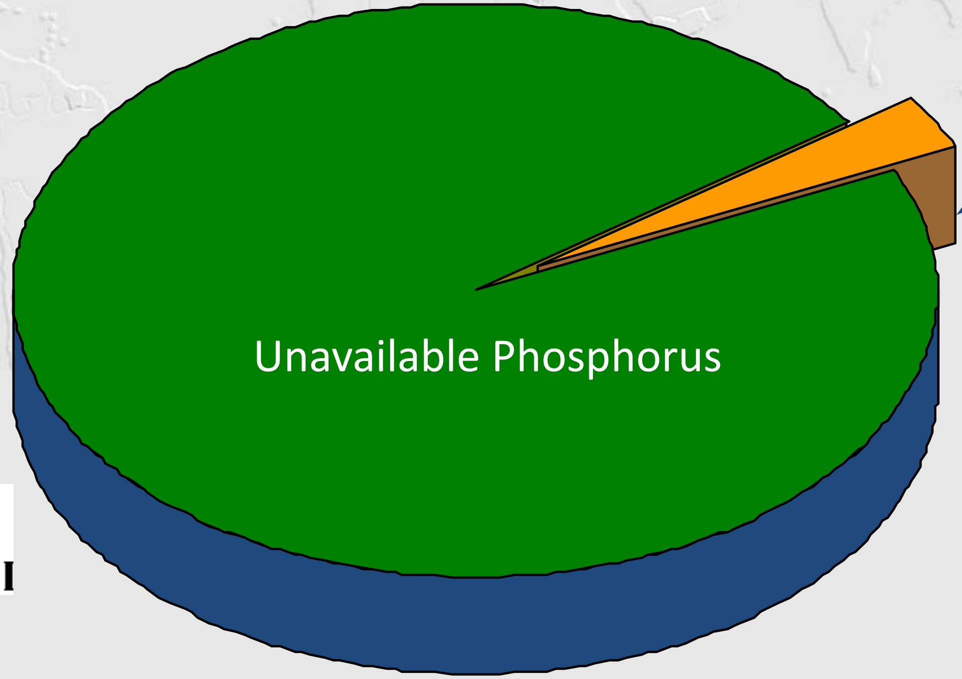
Phosphate is protected by MCT from precipitation with micronutrient metals such as Cu, Fe, Mn and Zn . . .

. . . making the micronutrient metals more available for absorption by the plant.

Phosphorus Inefficiency & Efficiency

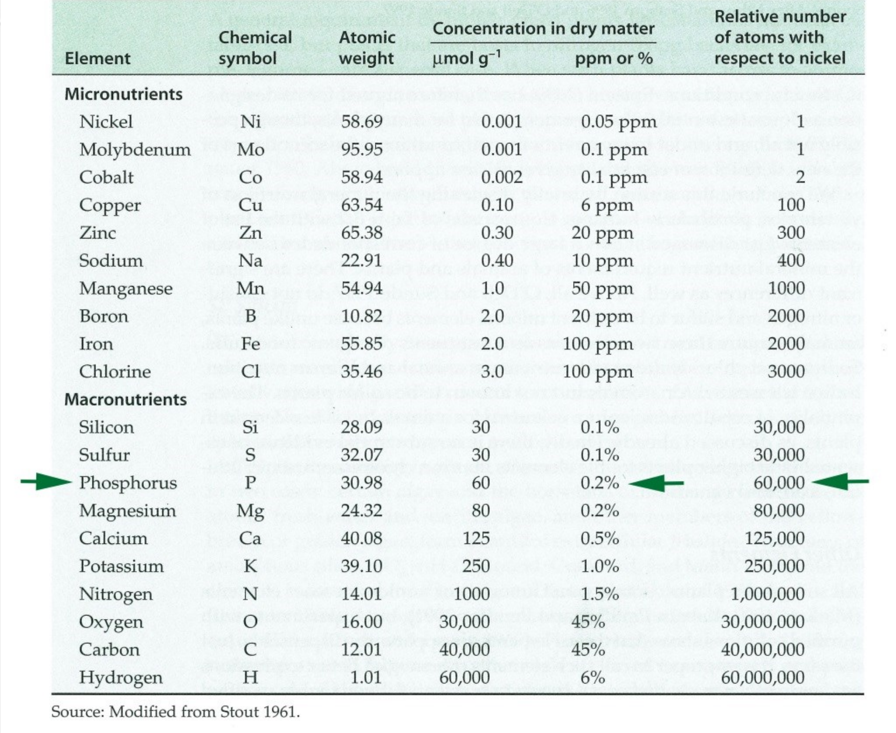
Phosphorus is very insoluble in the soil, so only a fraction from most P fertilizers is available to the crop.

Total phosphorus in soils (0 to 6 inches) ranges between 400-2,000 pounds/acre . . . but only a fraction of that is available to the plant for the absorption each season.



Phosphorus available for plant uptake

Phosphorus Deficiency



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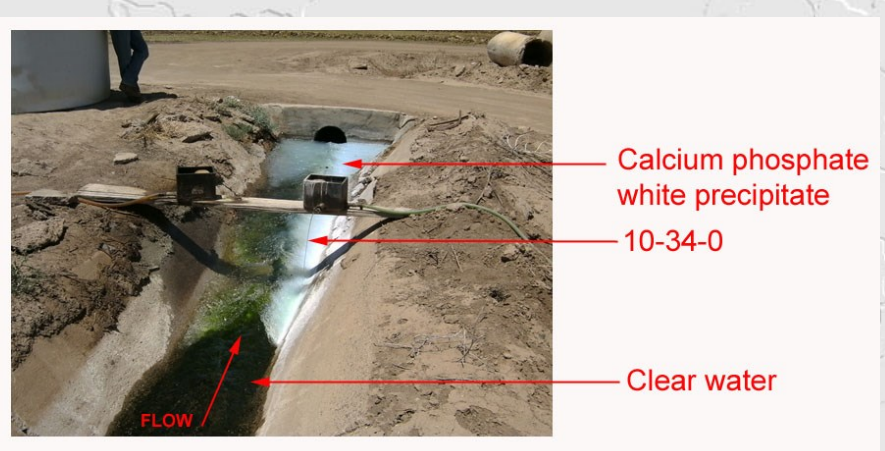
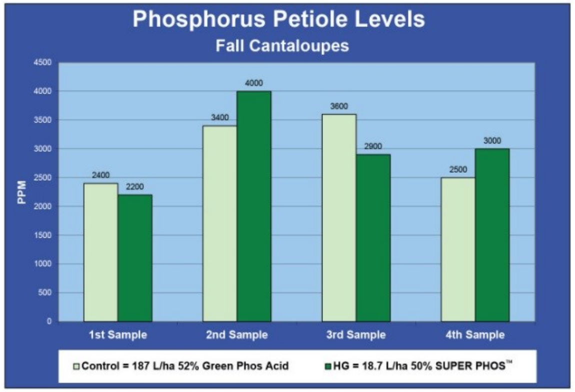
Phosphorus Fertilizers
Inefficient vs. Efficient

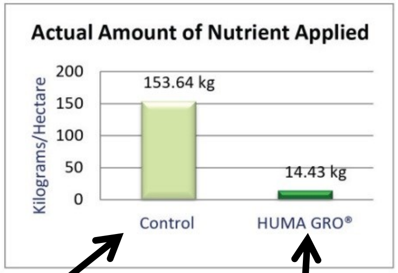
Addition of 10-34-0 to irrigation water resulted in formation of insoluble calcium phosphate



Inefficient Ammonium Polyphosphate
(APP, or 10-34-0)



HUMA GRO® SUPER PHOS™ product is so effective and efficient, it took 18.7 liters per hectare of SUPER PHOS™ (50% P_2O_5) to get the above results of phosphorus petiole levels in the plants. The SUPER PHOS™ amount used was only 10% of the control amount!



Inefficient phosphoric acid fertilizer

Efficient Huma Gro Super Phos™

Advantages of Micro Carbon Technology® (MCT) in Liquid Huma Gro® Fertilizers

- In the soil, MCT protects applied nutrients from loss due to formation of insoluble compounds.
  - Increases essential plant nutrient efficiency and water use efficiency.

- Liquid Huma Gro® fertilizers with MCT can be applied directly to the leaves,
  - Placing needed, essential nutrients very close to the principal site of photosynthesis.
  - Avoiding losses of nutrients in the soil.
  - Increases essential plant nutrient efficiency and water use efficiency.

Bio Huma Netics, Inc.
Global Value Chains Delivering Products with Micro Carbon Technology®

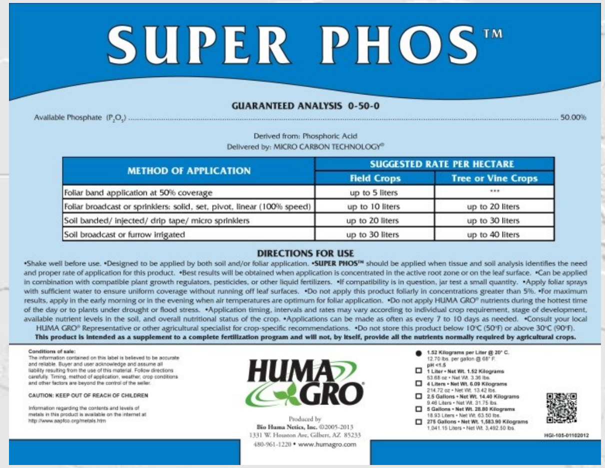
HUMA GRO® **products**

Probiotic SOLUTIONS® **products**

Manufacturing BHN Products

Fertilizers, pest control and wastewater treatment products

Some Huma Gro® Phosphorus Fertilizer Labels
One BHN product – many markets



SUPER PHOS™

GUARANTEED ANALYSIS 0-50-0

Available Phosphate (P_2O_5) 50.00%

Derived from: Phosphoric Acid
Delivered by: MICRO CARBON TECHNOLOGY®

METHOD OF APPLICATION	SUGGESTED RATE PER HECTARE	
	Field Crops	Tree or Vine Crops
Foliar band application at 50% coverage	up to 5 liters	***
Foliar broadcast or sprinklers: solid, set, pivot, linear (100% speed)	up to 10 liters	up to 20 liters
Soil banded/ injected/ drip tape/ micro sprinklers	up to 20 liters	up to 30 liters
Soil broadcast or furrow irrigated	up to 30 liters	up to 40 liters

DIRECTIONS FOR USE

•Shake well before use. •Designed to be applied by both soil and/or foliar application. •**SUPER PHOS™** should be applied when tissue and soil analysis identifies the need and proper rate of application for this product. •Best results will be obtained when application is concentrated in the active root zone or on the leaf surface. •Can be applied in combination with compatible plant growth regulators, pesticides, or other liquid fertilizers. •If compatibility is in question, jar test a small quantity. •Apply foliar sprays with sufficient water to ensure uniform coverage without running off leaf surfaces. •Do not apply this product foliarly in concentrations greater than 5%. •For maximum results, apply in the early morning or in the evening when air temperatures are optimum for foliar application. •Do not apply HUMA GRO® nutrients during the hottest time of the day or to plants under drought or flood stress. •Application timing, intervals and rates may vary according to individual crop requirement, stage of development, available nutrient levels in the soil, and overall nutritional status of the crop. •Applications can be made as often as every 7 to 10 days as needed. •Consult your local HUMA GRO® Representative or other agricultural specialist for crop-specific recommendations. •Do not store this product below 10°C (50°F) or above 30°C (90°F).

This product is intended as a supplement to a complete fertilization program and will not, by itself, provide all the nutrients normally required by agricultural crops.

Conditions of sale:
The information contained on this label is believed to be accurate and reliable. Buyer and user acknowledge and assume all liability resulting from the use of this material. Follow directions carefully. Timing, method of application, weather, crop conditions and other factors are beyond the control of the seller.

CAUTION: KEEP OUT OF REACH OF CHILDREN

Information regarding the contents and levels of metals in this product is available on the internet at http://www.aapfco.org/metals.htm

HUMA GRO

Produced by
Bio Huma Netics, Inc. ©2005-2013
1331 W. Houston Ave, Gilbert, AZ 85233
480-961-1220 • www.humagro.com

- ● **1.52 Kilograms per Liter @ 20° C.**
  12.70 lbs. per gallon @ 68° F.
  pH <1.5
- ☐ **1 Liter • Net Wt. 1.52 Kilograms**
  53.68 oz • Net Wt. 3.36 lbs.
- ☐ **4 Liters • Net Wt. 6.09 Kilograms**
  214.72 oz • Net Wt. 13.42 lbs.
- ☐ **2.5 Gallons • Net Wt. 14.40 Kilograms**
  9.46 Liters • Net Wt. 31.75 lbs.
- ☐ **5 Gallons • Net Wt. 28.80 Kilograms**
  18.93 Liters • Net Wt. 63.50 lbs.
- ☐ **275 Gallons • Net Wt. 1,583.90 Kilograms**
  1,041.15 Liters • Net Wt. 3,492.50 lbs.

HGI-105-01102012

English

国优马（BHN）公司
全球20多个国家或地区，
0多年的一种专业助剂
采用"微碳技术"，富
有机酸片段络合载体、
成分及天然酶，能络
或药物分子，有效提
药的利用率。

混合使用，减少氮肥
50%；
肥料（复合肥或复混肥）
，减少用量达30%；
的流失造成肥料浪费

肥，可长期保持肥料
和稳定性；
高农药的药效。

肥料颗粒的表面，混
后，尿素、碳铵施肥
半，施肥方法按原来
法施肥。每公斤尿素、
毫升减伴®（每50公
150ml减伴®）。

优马 HUMA GRO®
Energize Your Crops

始于1973

减伴® 助剂

净含量：150ml

技术指标：有机酸（分子量90-500）：8%

注意事项
- 远离儿童，避免口服；
- 使用时避免与皮肤、眼睛等直接接触；
- 因作物品种及各地土壤结构不同，视情况调节常规产品量施肥量。

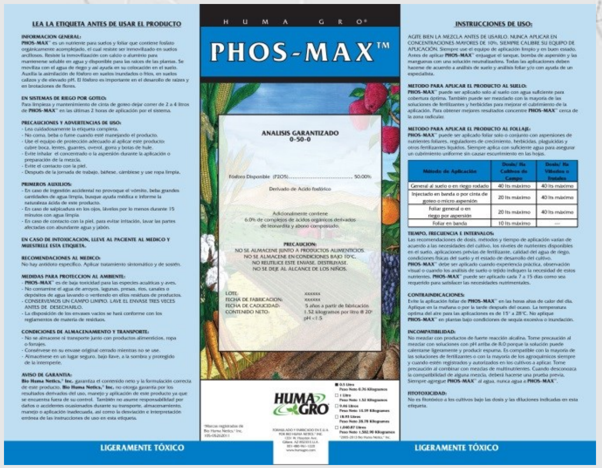
执行标准：Q/THAV1-2011
生产日期：见喷码　有效期：3年
原 产 地：美国
海关注册登记编码：312224-639
制造商：
美国优马生物技术有限公司
Bio Huma Netics,Inc
地　址：美国亚利桑那州，钱德勒市罗斯福南大道201号
销售商：
普罗生物技术（上海）有限公司
上海优马生物技术有限公司
地　址：上海市浦东新区庆达路67号
电　话：021-68917101
传　真：021-68917228

400-820-2789

6 947639 800141

美国优马生物技术有限公司

Mandarin Chinese



LEA LA ETIQUETA ANTES DE USAR EL PRODUCTO

INFORMACION GENERAL:
PHOS-MAX™ es un nutriente para suelos y foliar que contiene fosfato orgánicamente acomplejado, el cual resiste ser inmovilizado en suelos arcillosos. Resiste la inmovilización con calcio o aluminio para mantenerse soluble en agua y disponible para las raíces de las plantas. Se moviliza con el agua de riego y así ayuda en su colocación en el suelo. Auxilia la asimilación de fósforo en suelos inundados o fríos, en suelos calizos y de elevado pH. El fósforo es importante en el desarollo de raizes y en brotaciones de flores.

EN SISTEMAS DE RIEGO POR GOTEO:
Para limpieza y mantenimiento de cinta de goteo dejar correr de 2 a 4 litros de **PHOS-MAX™** en las últimas 2 horas de aplicación por el sistema.

PRECAUCIONES Y ADVERTENCIAS DE USO:
- Lea cuidadosamente la etiqueta completa.
- No coma, beba o fume cuando esté manejando el producto.
- Use el equipo de protección adecuado al aplicar este producto: cubre boca, lentes, guantes, overol, gorra y botas de hule.
- Evite inhalar el concentrado o la aspersión durante la aplicación o preparación de la mezcla.
- Evite el contacto con la piel.
- Después de la jornada de trabajo, báñese, cámbiese y use ropa limpia.

PRIMEROS AUXILIOS:
- En caso de ingestión accidental no provoque el vómito, beba grandes cantidades de agua limpia, busque ayuda médica e informe la naturaleza ácida de este producto.
- En caso de salpicadura en los ojos, lávelos por lo menos durante 15 minutos con agua limpia.
- En caso de contacto con la piel, para evitar irritación, lavar las partes afectadas con abundante agua y jabón.

EN CASO DE INTOXICACION, LLEVE AL PACIENTE AL MEDICO Y MUESTRELE ESTA ETIQUETA.

RECOMENDACIONES AL MEDICO:
No hay antídoto específico. Aplicar tratamiento sintomático y de sostén.

MEDIDAS PARA PROTECCION AL AMBIENTE:
- **PHOS-MAX™** es de baja toxicidad para las especies acuáticas y aves.
- No contamine el agua de arroyos, lagunas, presas, ríos, canales o depósitos de agua lavando o vertiendo en ellos residuos de productos.
- CONSERVEMOS UN CAMPO LIMPIO. LAVE EL ENVASE TRES VECES ANTES DE DESECHARLO.
- La disposición de los envases vacíos se hará conforme con los reglamentos de materia de residuos.

CONDICIONES DE ALMACENAMIENTO Y TRANSPORTE:
- No se almacene ni transporte junto con productos alimenticios, ropa o forrajes.
- Consérvese en su envase original cerrado mientras no se use.
- Almacénese en un lugar seguro, bajo llave, a la sombra y protegido de la intemperie.

AVISO DE GARANTIA:
Bio Huma Netics,® Inc. garantiza el contenido neto y la formulación correcta de este producto. **Bio Huma Netics,® Inc.** no otorga garantía por los resultados derivados del uso, manejo y aplicación de este producto ya que se encuentra fuera de su control. También no asume responsabilidad por daños o accidentes ocasionados durante su transporte, almacenamiento, manejo o aplicación inadecuada, así como la desviación e interpretación errónea de las instrucciones de uso en esta etiqueta.

LIGERAMENTE TÓXICO

HUMA GRO®

PHOS-MAX™

ANALISIS GARANTIZADO
0-50-0

Fósforo Disponible (P2O5)........ 50.00%

Derivado de Acido fosfórico

Adicionalmente contiene
6.0% de complejos de ácidos orgánicos derivados
de leonardita y abono composteado.

PRECAUCION:
NO SE ALMACENE JUNTO A PRODUCTOS ALIMENTICIOS.
NO SE ALMACENE EN CONDICIONES BAJO 10°C.
NO REUTILICE ESTE ENVASE. DESTRUYASE.
NO SE DEJE AL ALCANCE DE LOS NIÑOS.

LOTE: xxxxxx
FECHA DE FABRICACION: xxxxxx
FECHA DE CADUCIDAD: 5 años a partir de fabricación
CONTENIDO NETO: 1.52 kilogramos por litro @ 20°
pH <1.5

HUMA GRO

- ■ **0.5 Litro**
  Peso Neto 0.76 Kilogramos
- ☐ **1 Litro**
  Peso Neto 1.52 Kilogramos
- ☐ **9.46 Litros**
  Peso Neto 14.39 Kilogramos
- ☐ **18.93 Litros**
  Peso Neto 28.78 Kilogramos
- ☐ **1,040.87 Litros**
  Peso Neto 1,582.90 Kilogramos

*Marcas registradas de Bio Huma Netics,® Inc.
105-05262011

INSTRUCCIONES DE USO:

AGITE BIEN LA MEZCLA ANTES DE USARLO. NUNCA APLICAR EN CONCENTRACIONES MAYORES DE 10%. SIEMPRE CALIBRE SU EQUIPO DE APLICACIÓN. Siempre use el equipo de aplicación limpio y en buen estado. Antes de aplicar **PHOS-MAX™** enjuague el tanque, bomba de aspersión y las mangueras con una solución neutralizadora. Todas las aplicaciones deben hacerse de acuerdo a análisis de suelo y análisis foliar y/o con ayuda de un especialista.

METODO PARA APLICAR EL PRODUCTO AL SUELO:
PHOS-MAX™ puede ser aplicado solo al suelo con agua suficiente para cobertura óptima. También puede ser mezclado con la mayoría de las soluciones de fertilizantes y herbicidas para mejorar el cubrimiento de la aplicación. Para obtener mejores resultados concentre **PHOS-MAX™** cerca de la zona radicular.

METODO PARA APLICAR EL PRODUCTO AL FOLLAJE:
PHOS-MAX™ puede ser aplicado foliar solo o conjunto con aspersiones de nutrientes foliares, reguladores de crecimiento, herbicidas, plaguicidas y otros fertilizantes líquidos. Siempre aplica con suficiente agua para asegurar un cubrimiento uniforme sin causar escurrimiento en las hojas.

Método de Aplicación	Dosis/ Ha Cultivos de Campo	Dosis/ Ha Viñedos o Frutales
General al suelo o en riego rodado	40 lts máximo	40 lts máximo
Injectado en banda o por cinta de goteo o micro aspersión	20 lts máximo	40 lts máximo
Foliar general o en riego por aspersión	20 lts máximo	40 lts máximo
Foliar en banda	10 lts máximo	---

TIEMPO, FRECUENCIA E INTERVALOS:
Las recomendaciones de dosis, métodos y tiempo de aplicación varían de acuerdo a las necesidades del cultivo, los niveles de nutrientes disponibles en el suelo, aplicaciones prévias de fertilizante, calidad del agua de riego, condiciones físicas del suelo y el estado de desarrollo del cultivo. **PHOS-MAX™** debe ser aplicado cuando experiencia práctica, observación visual o cuando los análisis de suelo o tejido indiquen la necesidad de estos nutrientes. **PHOS-MAX™** puede ser aplicado cada 7 a 15 días como sea requerido para satisfacer las necesidades nutrimentales.

CONTRAINDICACIONES:
Evite la aplicación foliar de **PHOS-MAX™** en las horas altas de calor del día. Aplique en la mañana o por la tarde después del ocaso. La temperatura optima del aire para las aplicaciones es de 15° a 28°C. No aplique **PHOS-MAX™** en plantas bajo condiciones de sequía excesiva o inundación.

INCOMPATIBILIDAD:
No mezclar con productos de fuerte reacción alcalina. Tome precaución al mezclar con soluciones con pH arriba de 8.0 porque la solución puede calentarse ligeramente y producir espuma. Es compatible con la mayoría de las soluciones de fertilizantes o con la mayoría de los agroquímicos siempre y cuando estén registrados y autorizados en los cultivos a aplicar. Tome precaución al combinar con mezclas de multinutrientes. Cuando desconozca la compatibilidad de alguna mezcla, deberá hacerse una prueba previa. Siempre agregue **PHOS-MAX™** al agua, nunca agua a **PHOS-MAX™**.

FITOTOXICIDAD:
No es fitotóxico a los cultivos bajo las dosis y las diluciones indicadas en esta etiqueta.

LIGERAMENTE TÓXICO

Spanish

SUPER PHOS™

FOSFORİK ASİT

KULLANIM ŞEKLİ VE DOZLARI

•Kullanımdan önce çalkalayınız. •**SUPERPHOS®** tek başına yada diğer bitki koruma ve bitki besleme ürünleri ile birlikte kullanılabilir.
•Ürün kuvvetli asit (**pH=** 0,8)olup pestisitlerle karıştırılmadan önce karışım testi yapılması önerilir. •Kullanımdan önce karışım testi önerilir.

Uygulama şekli	Tarla bitkileri ve sebzeler	Meyve ağaçları ve bağ
Topraktan kaplama	[illegible]	[illegible]
Topraktan bant uygulamaları	[illegible]	[illegible]
Yapraktan	[illegible]	[illegible]

Sezon boyunca toplamda 1500cc-3000cc/da, bitki ihtiyacı doğrultusunda 10-15 gün arayla 3 -4 uygulama önerilir.
Asla uygun doz oranlarını aşmayınız, sadece gerekli yerlerde kullanınız!

UYARILAR

•Çocuklardan uzak tutunuz. •Göz, yüz ve deri ile temas ettirmeyiniz. • Kullanımdan sonra ellerinizi bol su ile yıkayınız.
• Kullanılmış boş ambalajları başka amaçlarla kullanmayınız. •Kullandıktan sonra ambalajları imha ediniz.

DEPOLAMA

•Ürünü serin ve kuru bir yerde muhafaza ediniz. • Ürünü direkt güneş ışığına maruz bırakmayınız. •Depolarda sigara içmeyiniz.
•Ateşle yaklaşmayınız. •Patlatıcı ve alev alıcı maddeler ve diğer kimyasallardan uzak tutunuz.•Depolama sıcaklığı 5 - 45℃ olmalıdır.

FİRMA BEYANI

•Ürünün bizim kontrolümüz dışında olduğundan hatalı, amaç dışı kullanımı ve depolanmasından doğacak sorunlardan firma mesuliyet kabul etmez. Spesifikasyonuna uygunluğu sadece ürün teslim sırasında firma garantisi altındadır.

HUMA GRO®

Üretici Firma:
BIO HUMA NETICS Inc.® ©2009
201 S. Roosevelt Chandler, AZ 85226
480-961-1220

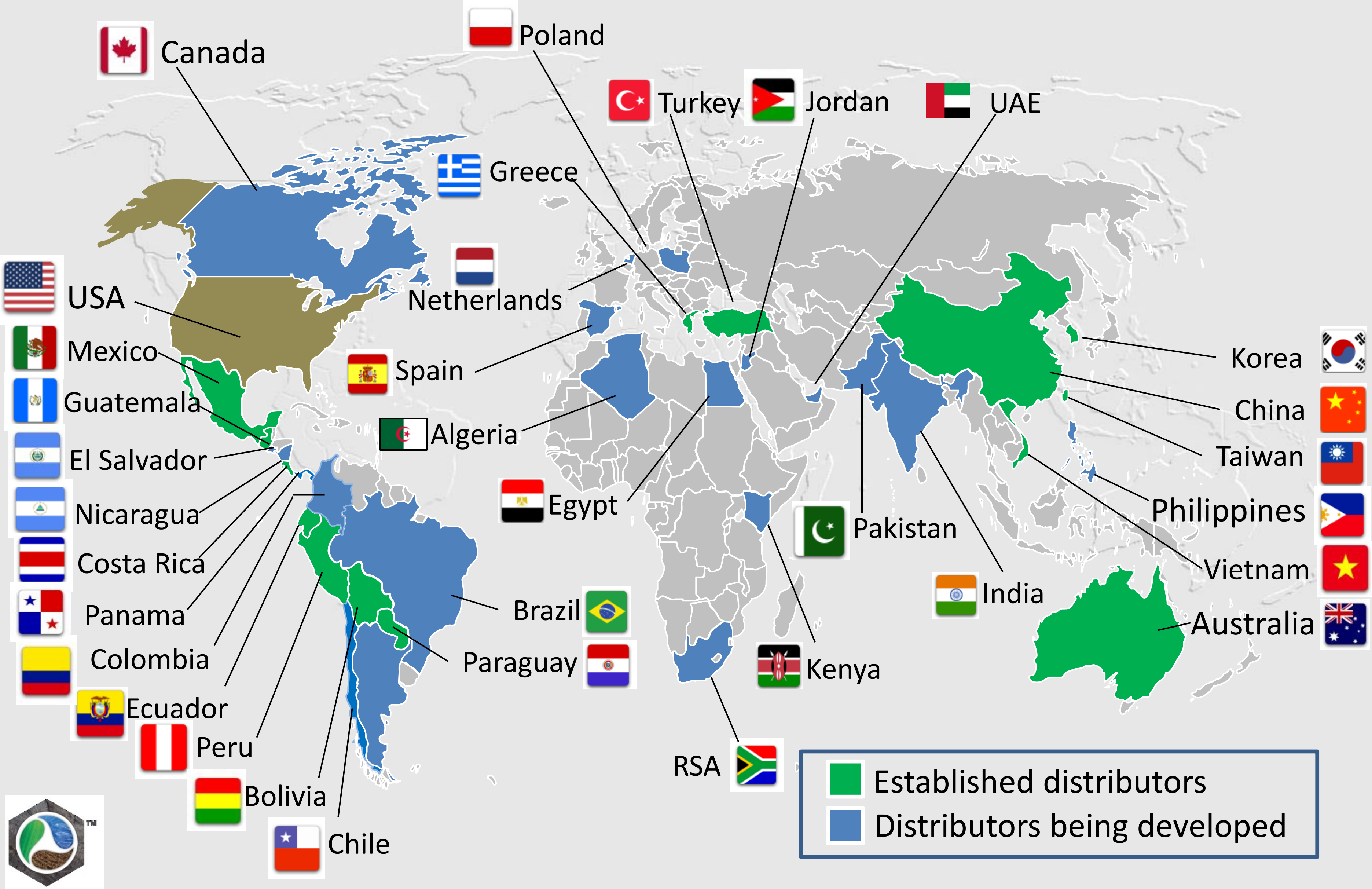
DİKKAT!
TAHRİŞ EDİCİDİR

Bakanlık Lisans No
Bakanlık Tescil No
Üretim Tarihi
Son Kullanma Tarihi

SPN AGRO

Turkish

2013 Worldwide Presence of Bio Huma Netics, Inc.



🟩 Established distributors
🟦 Distributors being developed

Greatest Benefits (Yield and WUE) in Areas with Access to Soil, Water and Plant Testing

Steps to Opening a New Country

- Initial Contact
- Face to face meetings
  - Dist training, grower visits, infield work
- Send samples of key products
- Begin registration process (if necessary)
- Begin field demonstrations of products on key crops
- Products Registered
- First container ordered
- Commercial

Value Chains – Markup to include costs and profit

- Manufacturer suggests retail cost of 100 units of local currency where product is to be used/unit volume of product (MSRP).
- Master distributor buys from manufacturer at 40 units of local currency/unit volume delivered to distributor’s port.
- Distributor pays between 10 units and 25 units of MSRP to import (duties, taxes).
- Distributor sells to sub-distributor for 65 units to 70 units of MSRP.
- Sub-distributor sells to retailer for 70 units to 75 units of MSRP.

BHN Value Chains in Spain

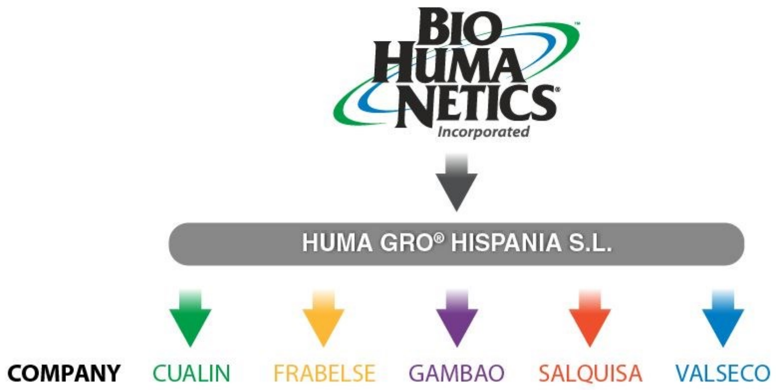
Regional Huma Gro® Supply Chains in Spain

Manufacturer

Crucial business relationship with master distributor

Exclusive, performance-based contracts with regional distributors

In each region, the regional distributor has business relationships with local distributors, commissioned agents, and/or end users



BIO HUMA NETICS Incorporated

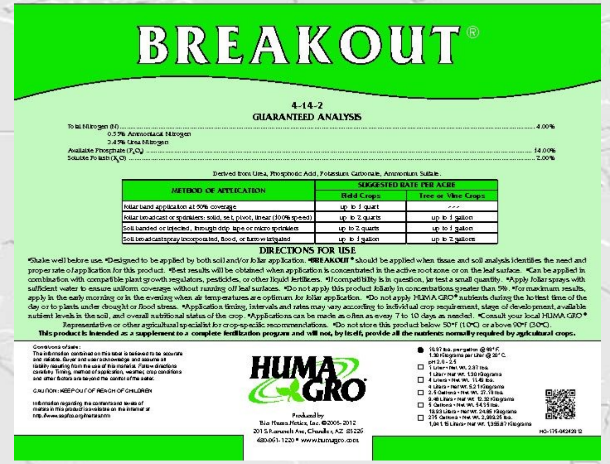
HUMA GRO® HISPANIA S.L.

COMPANY CUALIN FRABELSE GAMBAO SALQUISA VALSECO

BHN Value Chains in China

Packaging BHN Products in Sizes Appropriate for Small-Scale Farmers in China

Mixing of Huma Gro® Fertilizers in China



BREAKOUT®

4-14-2

GUARANTEED ANALYSIS

Total Nitrogen (N) 4.00%
0.55% Ammoniacal Nitrogen
3.45% Urea Nitrogen
Available Phosphate (P_2O_5) 14.00%
Soluble Potash (K_2O) 2.00%

Derived from Urea, Phosphoric Acid, Potassium Carbonate, Ammonium Sulfate.

METHOD OF APPLICATION	SUGGESTED RATE PER ACRE	
	Field Crops	Tree or Vine Crops
Foliar band application at 50% coverage	up to 1 quart	- - -
Foliar broadcast or sprinklers: solid, set, pivot, linear (100% speed)	up to 2 quarts	up to 1 gallon
Soil banded or injected, through drip tape or micro sprinklers	up to 2 quarts	up to 1 gallon
Soil broadcast spray incorporated, flood, or furrow irrigated	up to 1 gallon	up to 2 gallons

DIRECTIONS FOR USE

•Shake well before use. •Designed to be applied by both soil and/or foliar application. •**BREAKOUT®** should be applied when tissue and soil analysis identifies the need and proper rate of application for this product. •Best results will be obtained when application is concentrated in the active root zone or on the leaf surface. •Can be applied in combination with compatible plant growth regulators, pesticides, or other liquid fertilizers. •If compatibility is in question, jar test a small quantity. •Apply foliar sprays with sufficient water to ensure uniform coverage without running off leaf surfaces. •Do not apply this product foliarly in concentrations greater than 5%. •For maximum results, apply in the early morning or in the evening when air temperatures are optimum for foliar application. •Do not apply HUMA GRO® nutrients during the hottest time of the day or to plants under drought or flood stress. •Application timing, intervals and rates may vary according to individual crop requirement, stage of development, available nutrient levels in the soil, and overall nutritional status of the crop. •Applications can be made as often as every 7 to 10 days as needed. •Consult your local HUMA GRO® Representative or other agricultural specialist for crop-specific recommendations. •Do not store this product below 50°F (10°C) or above 90°F (30°C).

This product is intended as a supplement to a complete fertilization program and will not, by itself, provide all the nutrients normally required by agricultural crops.

Conditions of Sale:
The information contained on this label is believed to be accurate and reliable. Buyer and user acknowledge and assume all liability resulting from the use of this material. Follow directions carefully. Timing, method of application, weather, crop conditions and other factors are beyond the control of the seller.

CAUTION: KEEP OUT OF REACH OF CHILDREN

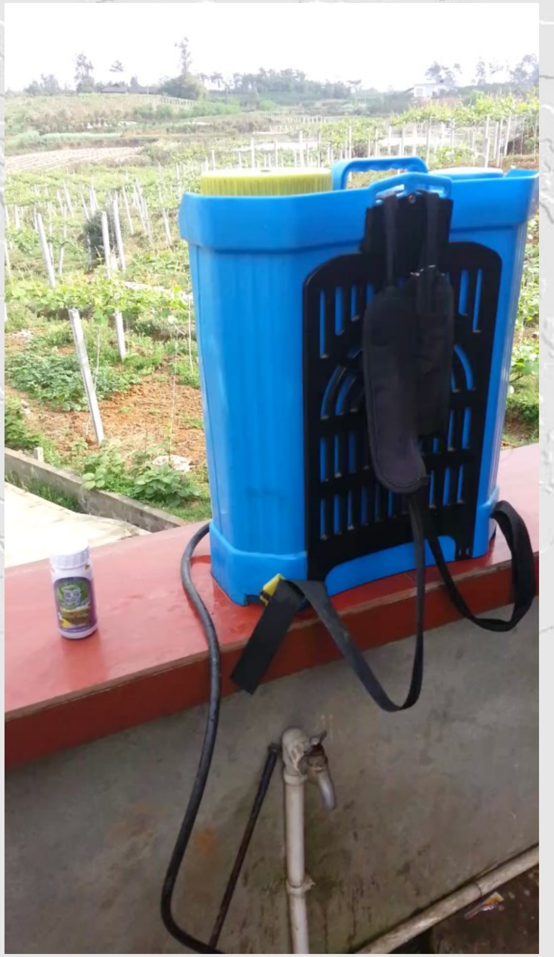
Information regarding the contents and levels of metals in this product is available on the internet at http://www.aapfco.org/metals.htm

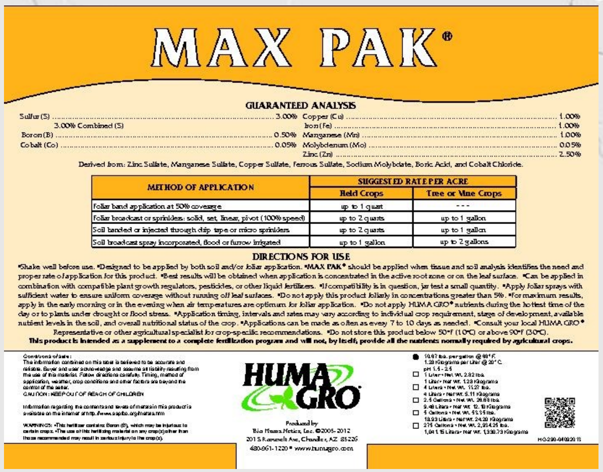
HUMA GRO®

Produced by
Bio Huma Netics, Inc. ©2005-2012
201 S Roosevelt Ave, Chandler, AZ 85226
480-961-1220 • www.humagro.com

● 10.87 lbs. per gallon @ 68° F.
1.30 Kilograms per Liter @ 20° C.
pH 2.0 - 2.5
☐ 1 Liter • Net Wt. 2.87 lbs.
1 Liter • Net Wt. 1.30 Kilograms
☐ 4 Liters • Net Wt. 11.49 lbs.
4 Liters • Net Wt. 5.21 Kilograms
☐ 2.5 Gallons • Net Wt. 27.18 lbs.
9.46 Liters • Net Wt. 12.32 Kilograms
☐ 5 Gallons • Net Wt. 54.35 lbs.
18.93 Liters • Net Wt. 24.65 Kilograms
☐ 275 Gallons • Net Wt. 2,989.25 lbs.
1,041.15 Liters • Net Wt. 1,355.87 Kilograms

HG-175-04242012





MAX PAK®

GUARANTEED ANALYSIS

Sulfur (S) 3.00%
3.00% Combined (S)
Boron (B) 0.50%
Cobalt (Co) 0.05%
Copper (Cu) 1.00%
Iron (Fe) 1.00%
Manganese (Mn) 1.00%
Molybdenum (Mo) 0.05%
Zinc (Zn) 2.50%

Derived from: Zinc Sulfate, Manganese Sulfate, Copper Sulfate, Ferrous Sulfate, Sodium Molybdate, Boric Acid, and Cobalt Chloride.

METHOD OF APPLICATION	SUGGESTED RATE PER ACRE	
	Field Crops	Tree or Vine Crops
Foliar band application at 50% coverage	up to 1 quart	- - -
Foliar broadcast or sprinklers: solid, set, linear, pivot (100% speed)	up to 2 quarts	up to 1 gallon
Soil banded or injected through drip tape or micro sprinklers	up to 2 quarts	up to 1 gallon
Soil broadcast spray incorporated, flood or furrow irrigated	up to 1 gallon	up to 2 gallons

DIRECTIONS FOR USE

•Shake well before use. •Designed to be applied by both soil and/or foliar application. •**MAX PAK®** should be applied when tissue and soil analysis identifies the need and proper rate of application for this product. •Best results will be obtained when application is concentrated in the active root zone or on the leaf surface. •Can be applied in combination with compatible plant growth regulators, pesticides, or other liquid fertilizers. •If compatibility is in question, jar test a small quantity. •Apply foliar sprays with sufficient water to ensure uniform coverage without running off leaf surfaces. •Do not apply this product foliarly in concentrations greater than 5%. •For maximum results, apply in the early morning or in the evening when air temperatures are optimum for foliar application. •Do not apply HUMA GRO® nutrients during the hottest time of the day or to plants under drought or flood stress. •Application timing, intervals and rates may vary according to individual crop requirement, stage of development, available nutrient levels in the soil, and overall nutritional status of the crop. •Applications can be made as often as every 7 to 10 days as needed. •Consult your local HUMA GRO® Representative or other agricultural specialist for crop-specific recommendations. •Do not store this product below 50°F (10°C) or above 90°F (30°C).

This product is intended as a supplement to a complete fertilization program and will not, by itself, provide all the nutrients normally required by agricultural crops.

Conditions of Sale:
The information contained on this label is believed to be accurate and reliable. Buyer and user acknowledge and assume all liability resulting from the use of this material. Follow directions carefully. Timing, method of application, weather, crop conditions and other factors are beyond the control of the seller.
CAUTION: KEEP OUT OF REACH OF CHILDREN

Information regarding the contents and levels of metals in this product is available on the internet at http://www.aapfco.org/metals.htm

WARNINGS: •This fertilizer contains Boron (B), which may be injurious to certain crops. •The use of this fertilizing material on any crop(s) other than those recommended may result in serious injury to the crop(s).

HUMA GRO®

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201 S Roosevelt Ave, Chandler, AZ 85226
480-961-1220 • www.humagro.com

● 10.67 lbs. per gallon @ 68° F.
1.28 Kilograms per Liter @ 20° C.
pH 1.5 - 2.5
☐ 1 Liter • Net Wt. 2.82 lbs.
1 Liter • Net Wt. 1.28 Kilograms
☐ 4 Liters • Net Wt. 11.27 lbs.
4 Liters • Net Wt. 5.11 Kilograms
☐ 2.5 Gallons • Net Wt. 26.68 lbs.
9.46 Liters • Net Wt. 12.10 Kilograms
☐ 5 Gallons • Net Wt. 53.35 lbs.
18.93 Liters • Net Wt. 24.20 Kilograms
☐ 275 Gallons • Net Wt. 2,934.25 lbs.
1,041.15 Liters • Net Wt. 1,330.73 Kilograms

HG-290-04092013

Application of Huma Gro® Fertilizers to Kiwifruit in China

BHN Value Chains in Nicaragua

Application of Huma Gro® Fertilizer to Coffee Seedlings in Nicaragua

Close-Up View of Application of Huma Gro® Fertilizer to Coffee Seedlings in Nicaragua

Probiotic™
SOLUTIONS®

Wastewater Reuse from Small-Town Sewage, Dairy, and Abattoir Enhanced Treatment for Crop Irrigation

Economic Benefits of Bio Energizer®-Reclaimed Small-Town Sewage in Texas

- **Raw sewage** (“municipal wastewater”) passes through a bar screen at the headworks to capture rags, bags, wood and other large objects.
- The sewage proceeds through a series of 3 lagoons to decrease solids and increase available plant nutrients.
- After the water has been in the system for approximately 30 days, it is pumped from the last lagoon and applied to a hay field via sprinklers on a typical irrigation schedule.
- *The treated water has been an economic boon to the farmer who bails the hay and sells it to the ranchers who no longer have to purchase hay produced elsewhere.*

Simple bar screen

Headworks
and bar screen

Lagoon treated with Bio Energizer®

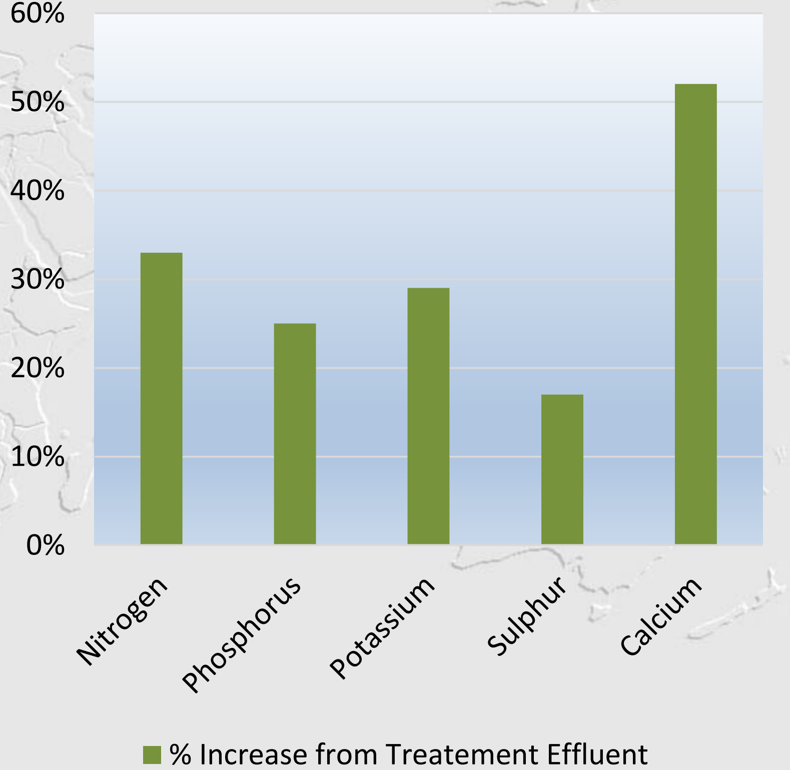
Irrigation pivot in background

Irrigation of forage with
treated wastewater

Improvement of Forage Quality Using Dairy Wastewater Treated by Bio Energizer® in Australia

Irrigated *Phalaris* pasture grass

Increase in Plant Tissue Concentrations Resulting from Effluent Treated with Bio Energizer®



Qualitative and quantitative improvements in *Phalaris* pasture grasses irrigated with effluent pond water treated with Bio Energizer®, compared to a control pasture irrigated with non-treated **diary wastewater**.

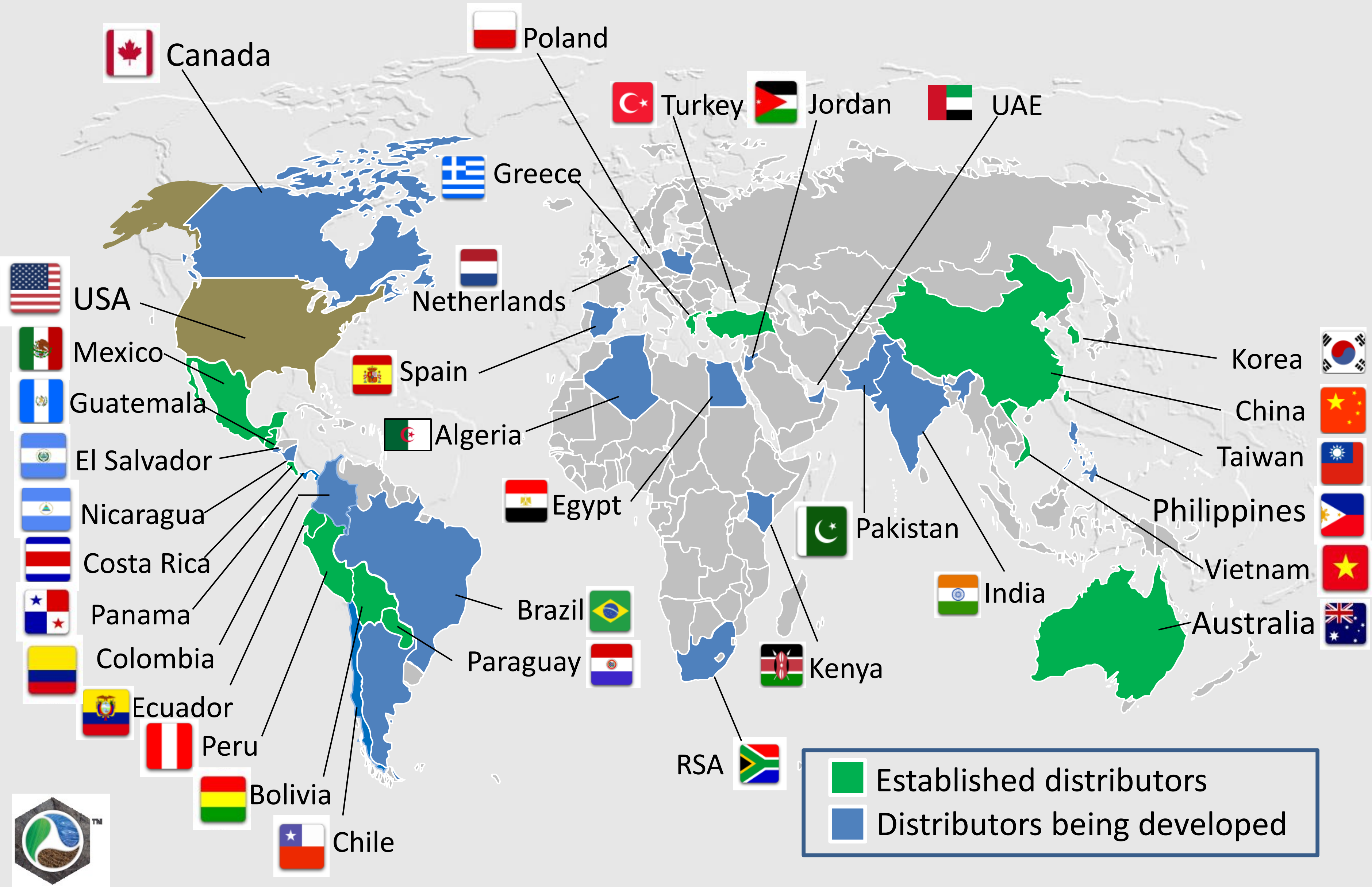
Treated Wastewater from Ovine Abattoir when Treated with Bio Energizer® Improves Wheat & Canola Production in Australia

Treated wastewater from a **ovine abattoir** is drawn off the last "polishing" treatment pond below and pumped to an adjacent field where crops are rotated annually.

After using Bio Energizer® in the pond system for a year the abattoir won "Wheat Crop of the Year". And this, year 2013, the operator exclaimed "You should see my canola crop it is this high" – gesturing with his hand to about 3.5 feet high.

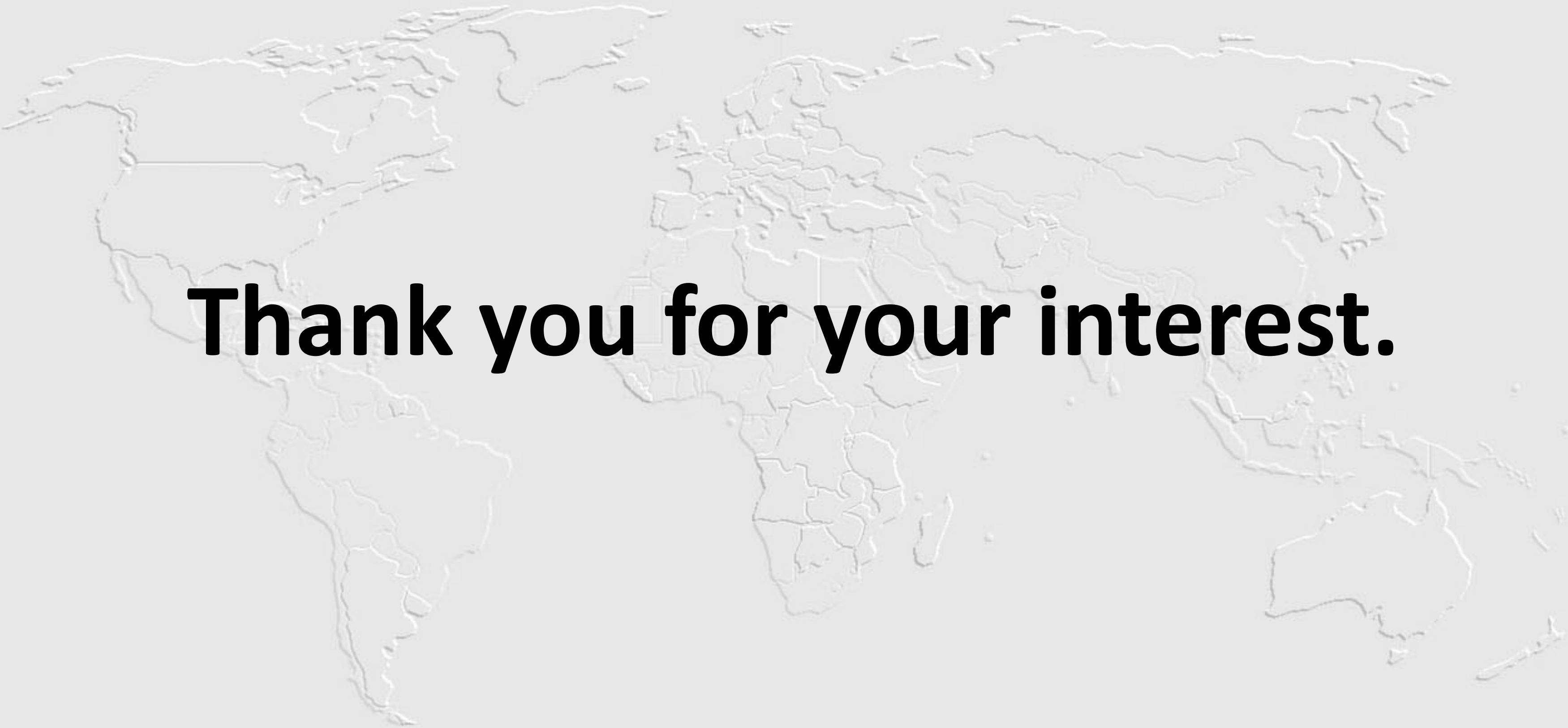
The operator of the abattoir's wastewater treatment facility was clearly excited about the growth of his latest crop, due to the addition of Bio Energizer® into the treatment pond system as compared to previous years without it.

2013 Worldwide Presence of Bio Huma Netics, Inc.



🟩 Established distributors

🟦 Distributors being developed



Thank you for your interest.

Additional information: http://bhn.us or tom@bhn.us