FERTILIZER BEST MANAGEMENT PRACTICES

What Level of Adaptation to Local Conditions is Realistic in a Developing Country Context?

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Fertilizer Best Management Practices

Similar Concepts:

- ***Fertilizer Use Efficiency***
- ***Crop Nutrient Management***
- ***Efficient Plant Nutrition Management***
- ***Integrated Nutrient Management***
- ***Site-Specific Nutrient Management***

Related Concepts:

- ***Precision Farming***

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Presentation Outline

Introduction

- The Global Context
- CGIAR System and ICARDA

The West Asia-North Africa Region

- Dryland Agriculture and Drought
- The Changing Scene
- Fertilizer Use Trends

Improving Fertilizer Use Efficiency

- Deficiency Diagnosis to Integrated Nutrient Use
- Balanced Fertilization
- Soil and Physical Constraints
- Approaches to Efficient Use

Conclusions

- Possible Solutions

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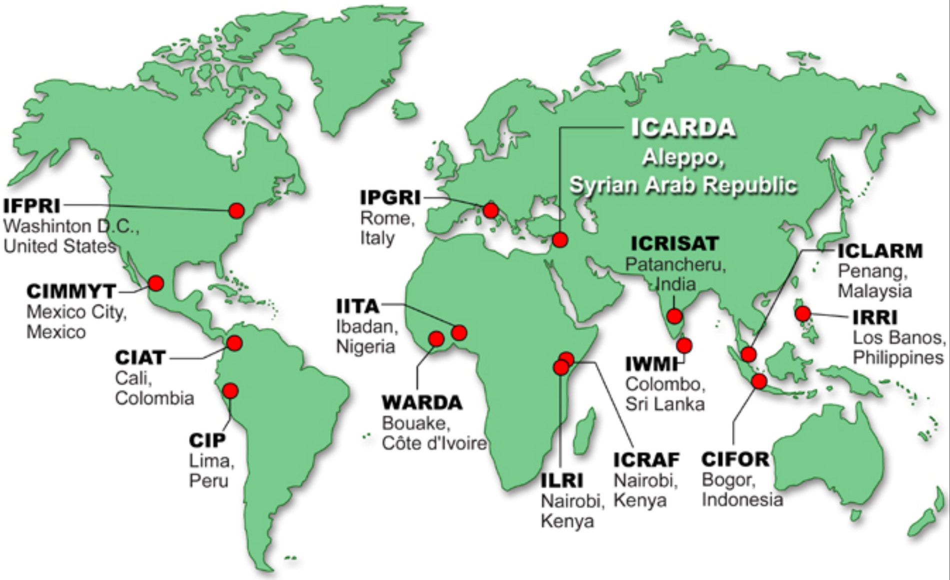
The CGIAR Centers

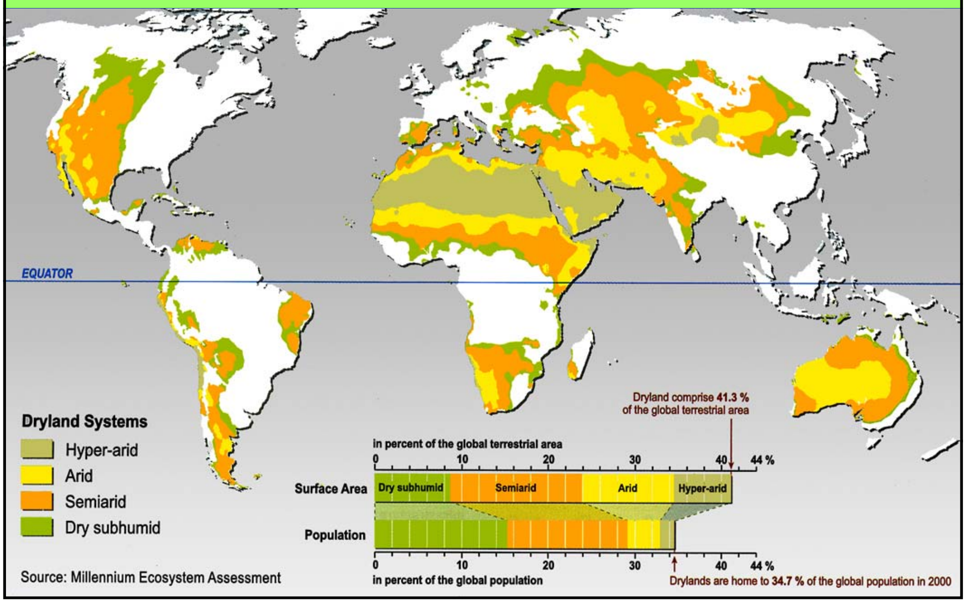


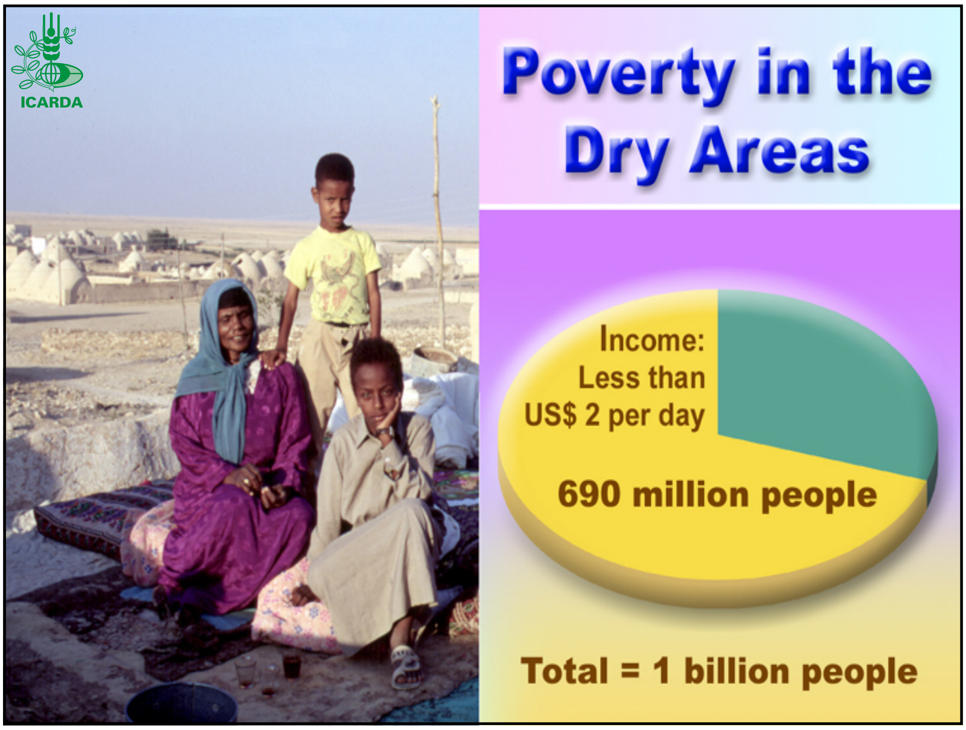
Challenges

- Poverty
- Population growth
- Rural to urban migration
- Fresh water scarcity
- Land degradation
- Loss of agrobiodiversity

- Global warming
- Diversity of agroecologies
- Weak research infrastructure
- Inadequate investment in research
- Weak information technology infrastructure and capacity

Drylands and their Categories

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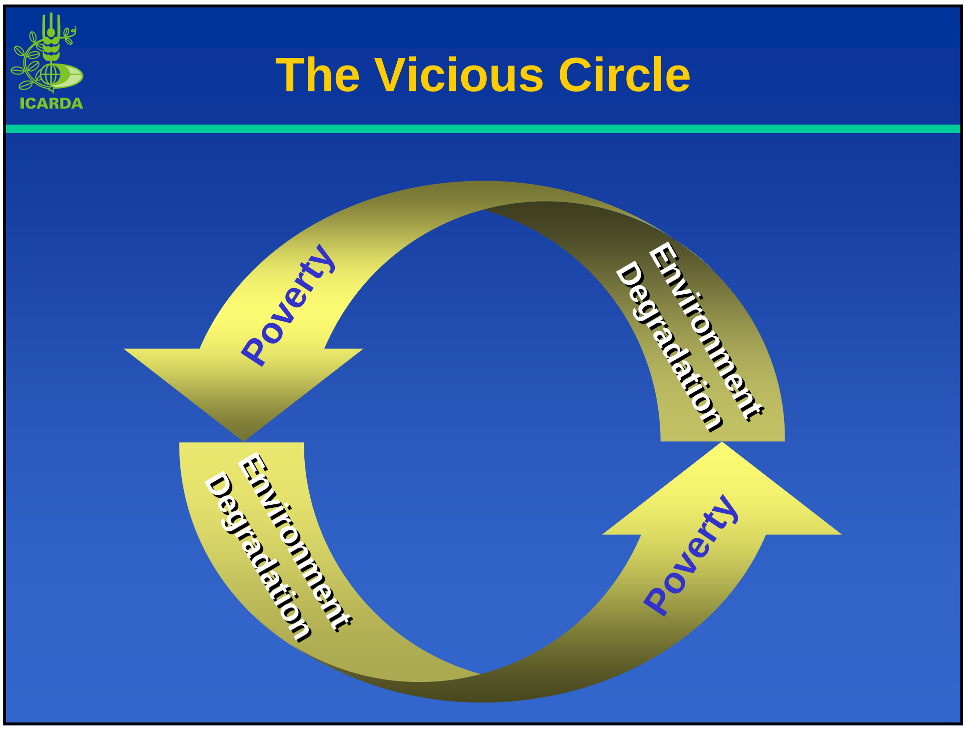
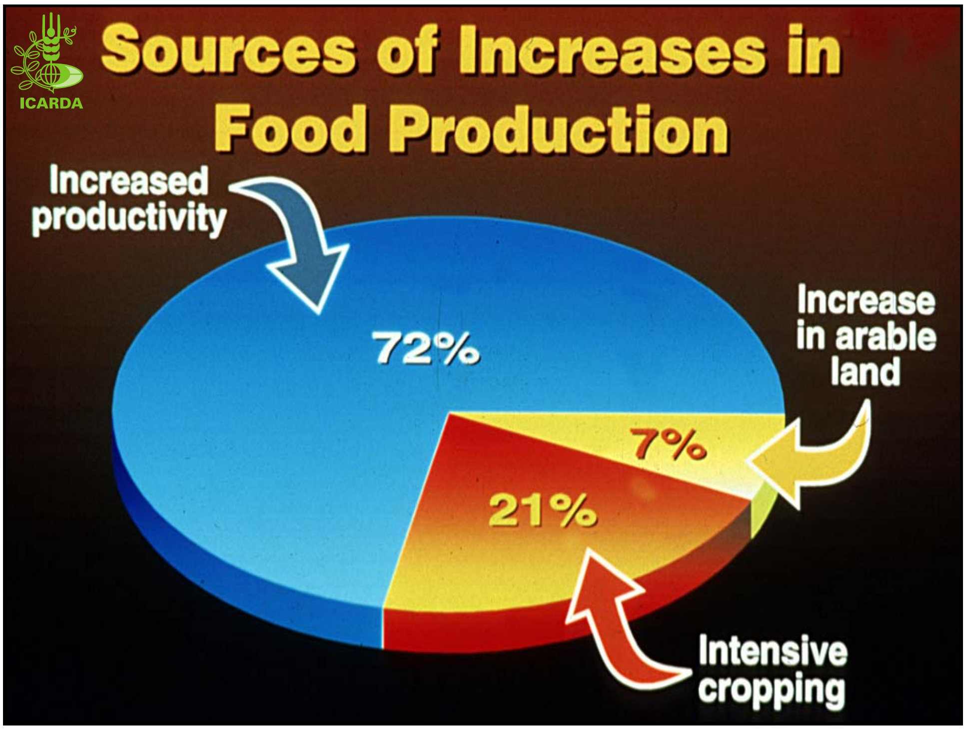
Poverty in the Dry Areas
Income:
Less than
US$ 2 per day
690 million people
Total = 1 billion people


ICARDA
The Vicious Circle
Poverty
Environment Degradation
Poverty
Environment Degradation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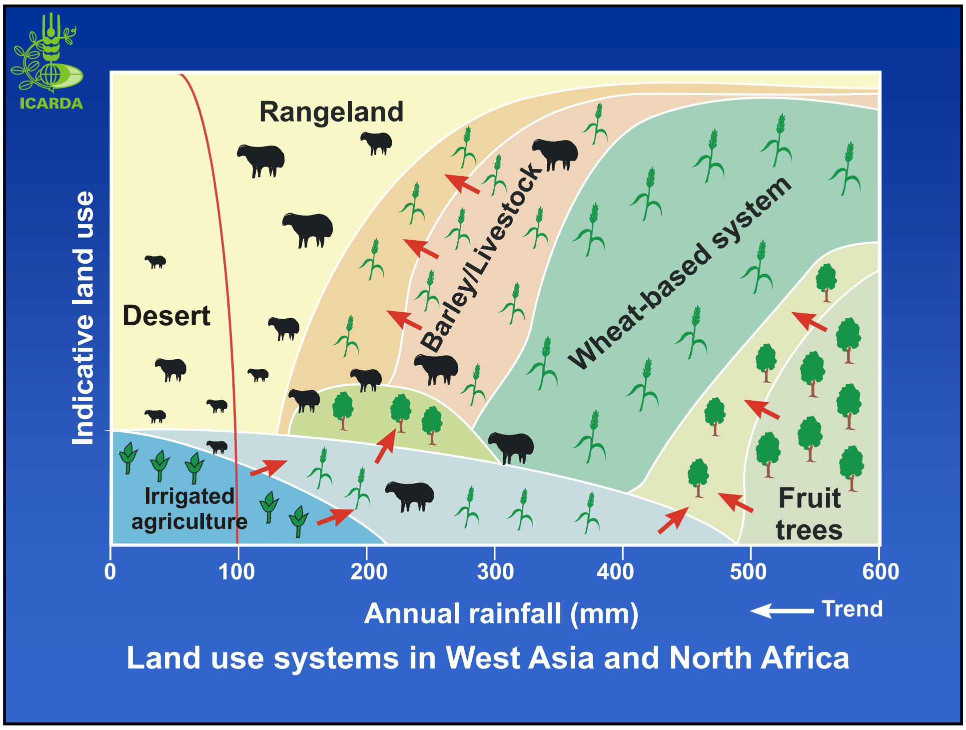
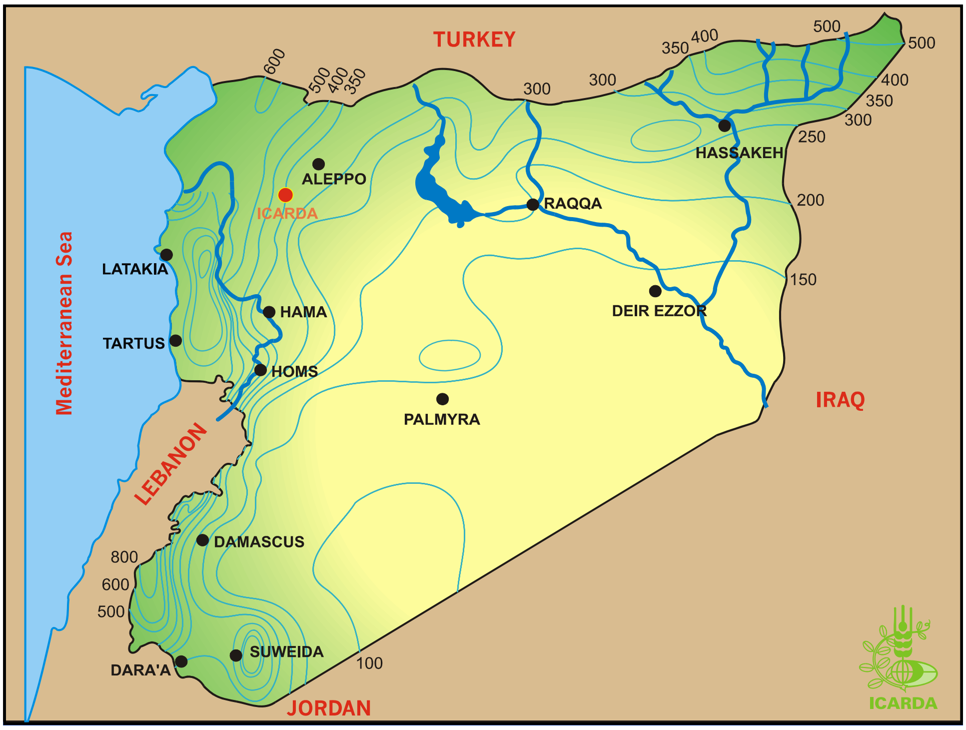
Sources of Increases in Food Production
Increased productivity
72%
Increase in arable land
7%
21%
Intensive cropping


ICARDA
Rangeland
Desert
Barley/Livestock
Wheat-based system
Irrigated agriculture
Fruit trees
Indicative land use
0
100
200
300
400
500
600
Annual rainfall (mm)
Trend
Land use systems in West Asia and North Africa



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Crop Production Constraints

- Drought – major factor in dryland agriculture (200-500 mm yr-1)
- Nitrogen and Phosphorus
  - Main focus of ICARDA's Regional Soil Test Calibration Network
- Emphasis on Micronutrient relatively recent
  - Zinc and Iron potentially important

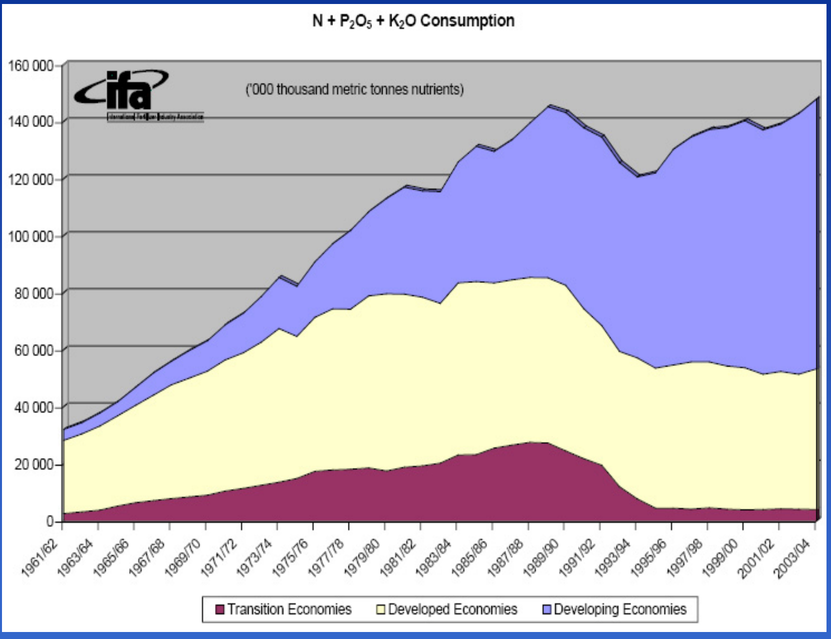
Trends Related to Nutrient Use

1970s

- Most cropping systems rainfed (cereals, legumes).
- Minimal use of chemical fertilizers.
- Fallow to conserve moisture
- Limited machinery use.

1990s

- Increased use of irrigation (full, supplemental) in rainfed areas.
- Substantial fertilizer input.
- Reduced fallow, increased monoculture.
- Greater cropping diversity - nuts, fruits, medicinal plants.



Factors Constraining Efficient Fertilizer Use

Socio-economic

- Mainly small and often fragmented holdings
- Limited farm income; little left over for investment above household needs
- Poor credit availability
- Uncertain land tenure
- Weak infrastructure
- Poorly developed extension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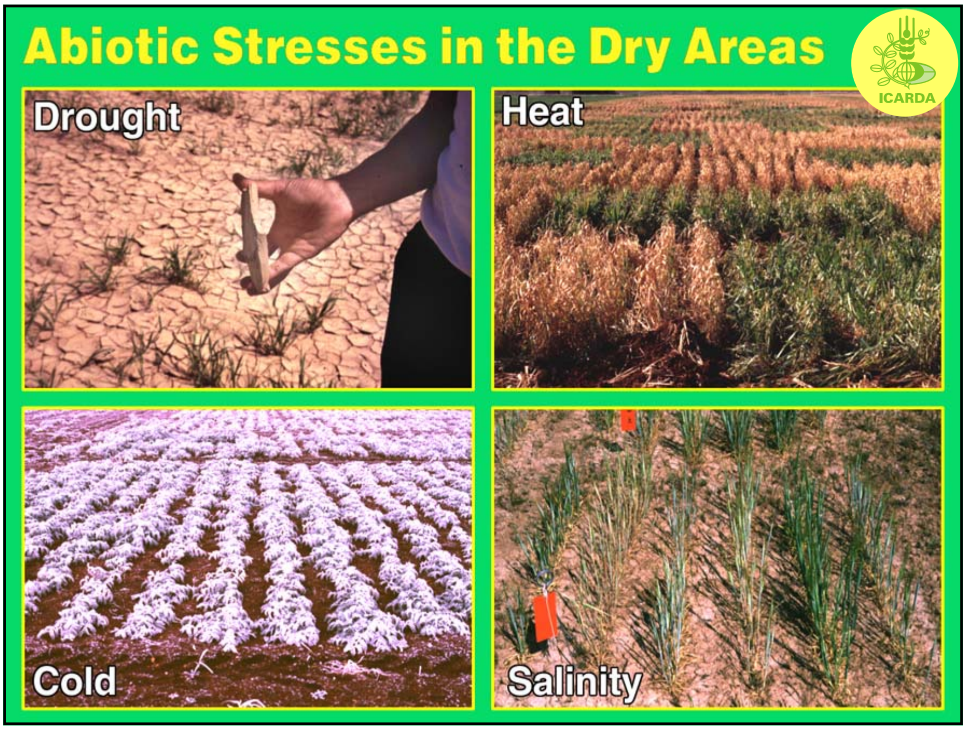
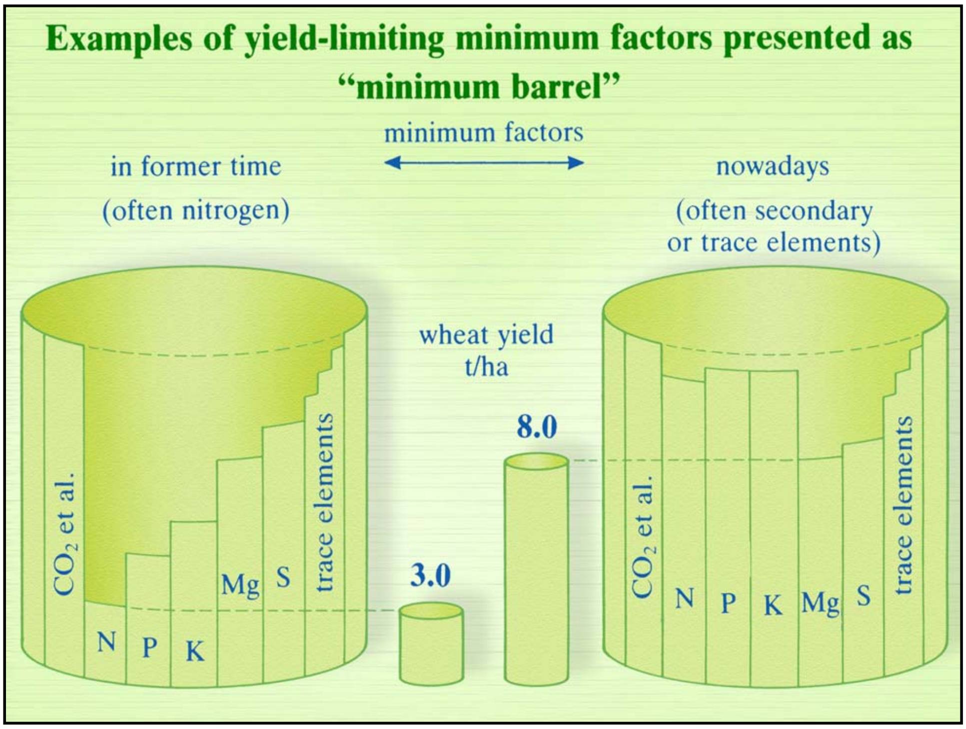
Factors Constraining Efficient Fertilizer Use

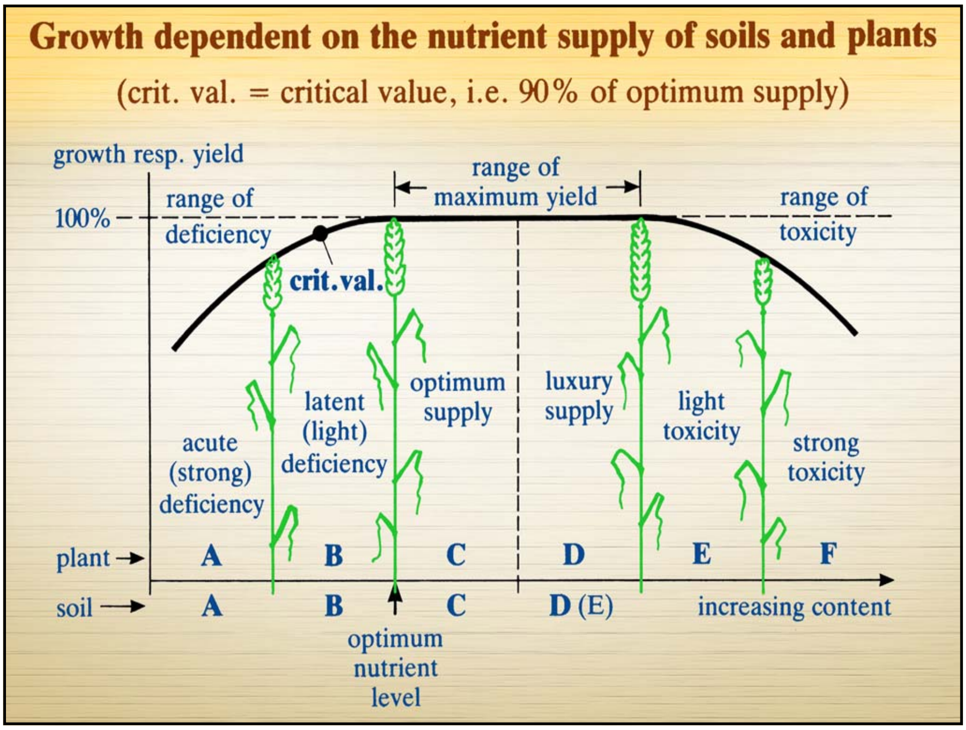
Biophysical

- Uncertain rainfall conditions, high incidence of drought
- Variable soils – heavy clays to shallow rocky
- Cold and heat stress
- Diseases
- Weeds





Examples of yield-limiting minimum factors presented as "minimum barrel"
minimum factors
in former time
(often nitrogen)
nowadays
(often secondary or trace elements)
wheat yield t/ha
8.0
3.0
CO_2 et al.
N
P
K
Mg
S
trace elements
CO_2 et al.
N
P
K
Mg
S
trace elements



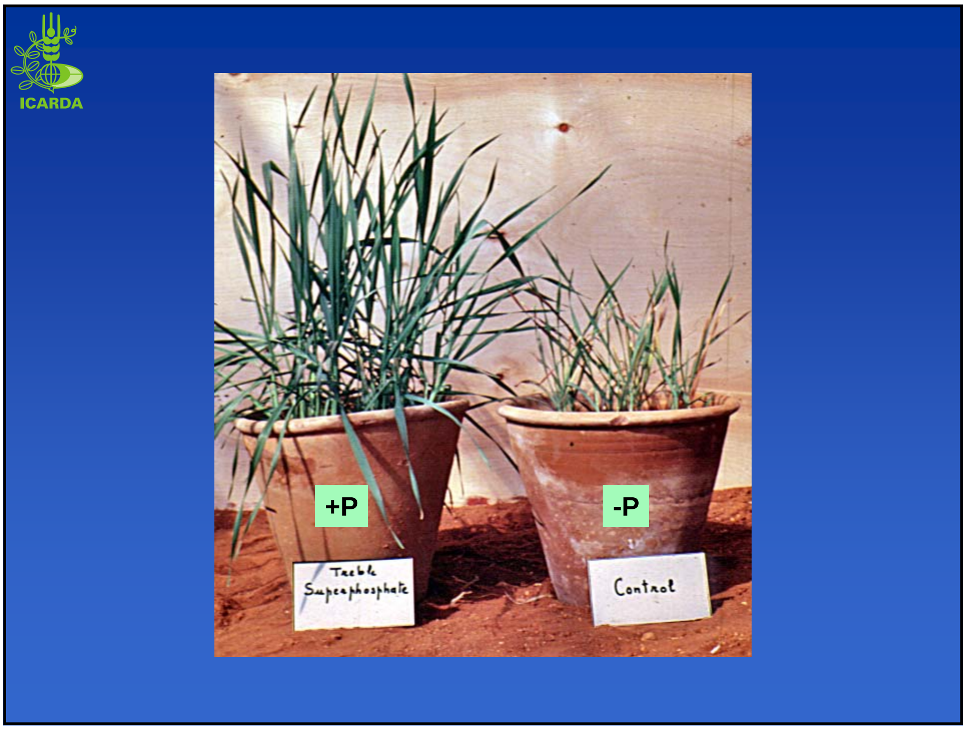
Growth dependent on the nutrient supply of soils and plants
(crit. val. = critical value, i.e. 90% of optimum supply)
growth resp. yield
100%
range of deficiency
range of maximum yield
range of toxicity
crit.val.
acute (strong) deficiency
latent (light) deficiency
optimum supply
luxury supply
light toxicity
strong toxicity
plant
A
B
C
D
E
F
soil
A
B
C
D (E)
increasing content
optimum nutrient level

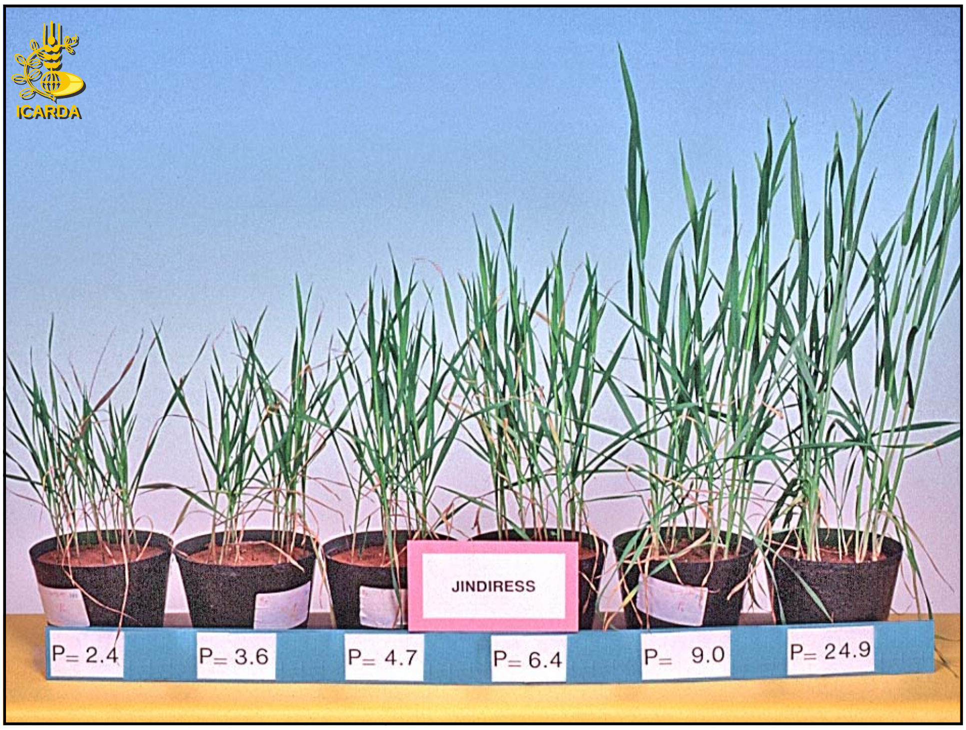
ICARDA Research Chronology

- Early 1980
  - Identify nutrient deficiencies
  - Field crop response, N, P
  - Rainfall/nutrient interaction
  - Fertilizer application methods
  - Fertilizer nutrient behavior, use efficiency
- Late 1980s – Early 1990s
  - Long-term cropping systems trial (involving N, P fertilizers)
- Late 1990s – date
  - Focus on micronutrients (Zn, Fe, B)
  - Role of soil organic matter
  - Nutrients in irrigation, wastewater

Nutrients in West Asia-North Africa: General Picture

- Soils low in organic matter---limited reserve of N, S.
  - Limited supply of manures
- Mineral N (Ammonium-nitrate) generally low
  - Fertilization required for most crops, except N-fixing legumes.
  - N use related to rainfall, irrigation, crop intensification
  - Fertilizer N Use Efficiency <50% (losses from volatilization, leaching, residual).
- P inherently low, but buildup with continued fertilization
- K generally well supplied, except sandy soils, irrigated conditions, potatoes
- Ca, Mg, S: well supplied
- Micronutrients, increasing problems with Zn, Fe, B.


ICARDA
+P
-P
Treble
Superphosphate
Control


ICARDA
JINDIRESS
P= 2.4
P= 3.6
P= 4.7
P= 6.4
P= 9.0
P= 24.9

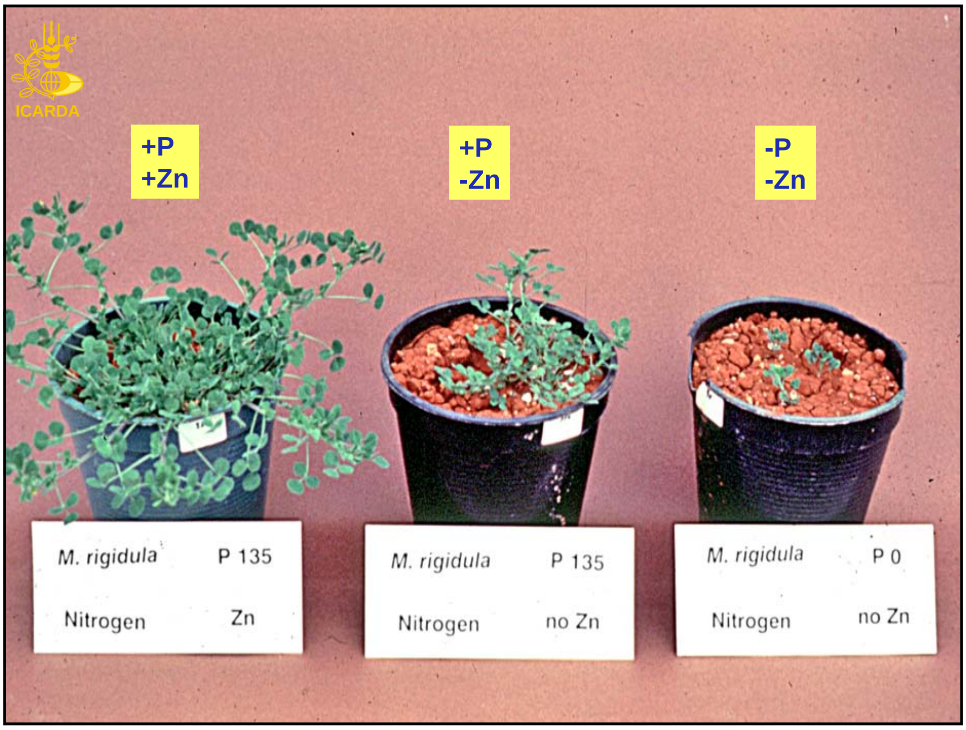

ICARDA
P_ 0
P_ 120
BROADCASI


ICARDA
P_ 80
BROADCAST
P_ 40
BANDING

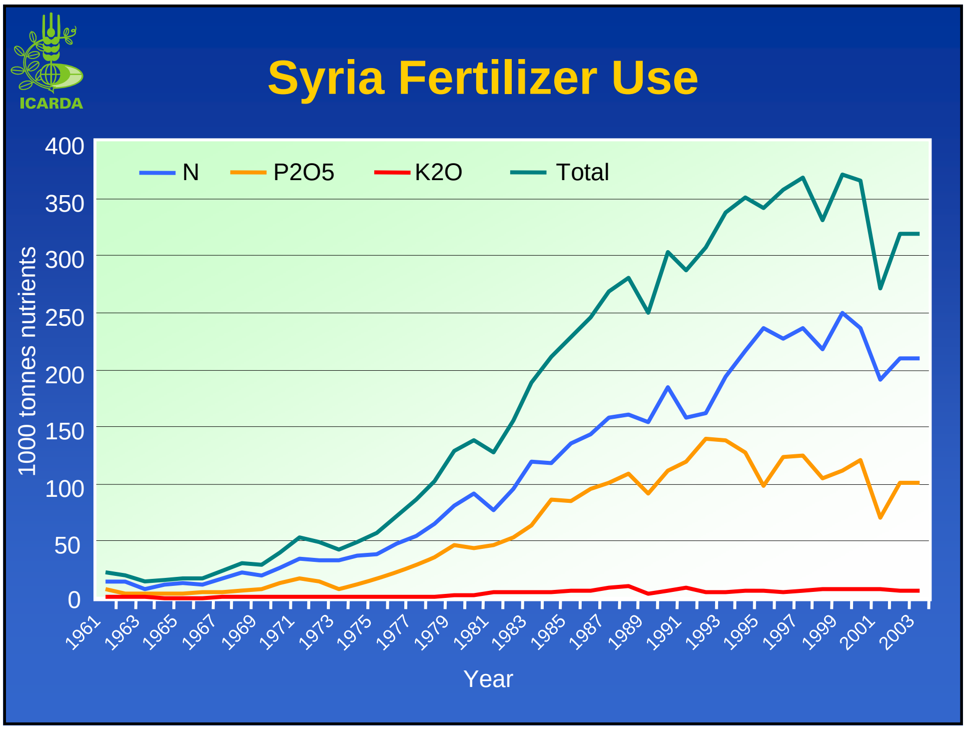

ICARDA
N60
P50
N0
P50


ICARDA
N40 P0
N40 P90


ICARDA
N
120
N
80
N
40
N
0


ICARDA
+P
+Zn
+P
-Zn
-P
-Zn
M. rigidula P 135
Nitrogen Zn
M. rigidula P 135
Nitrogen no Zn
M. rigidula P 0
Nitrogen no Zn


ICARDA
+Zn
-Zn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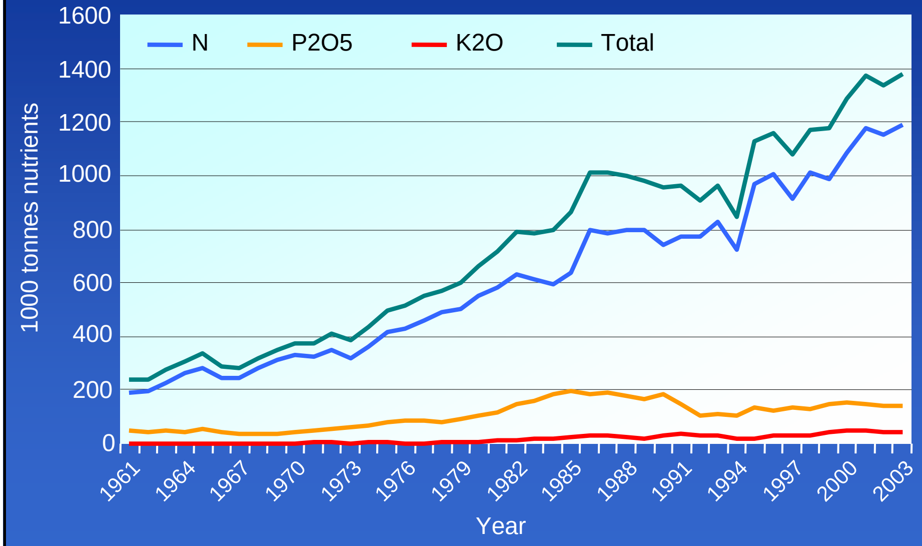
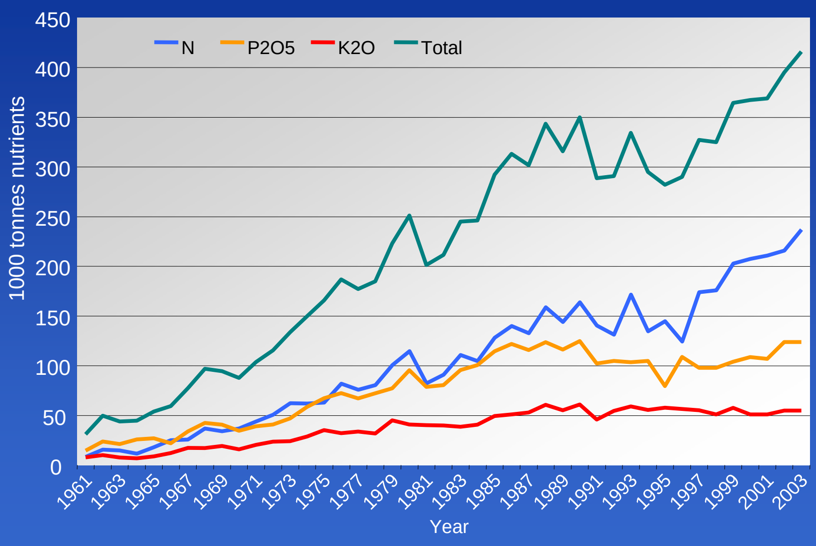
Syria Fertilizer Use
N
P2O5
K2O
Total
1000 tonnes nutrients
Year
0
50
100
150
200
250
300
350
400
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003

Egypt Fertilizer Use



Morocco Fertilizer Use



Fertilizer Use Ratios

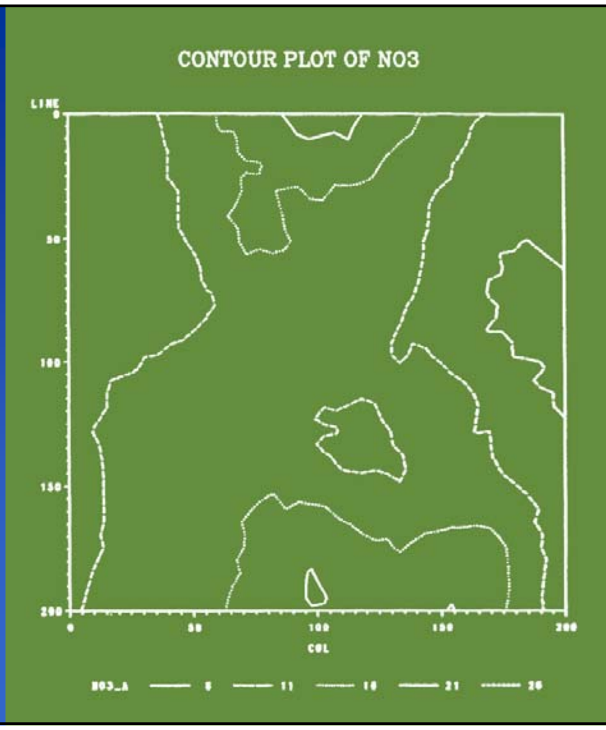
	N	P_2O_5	K_2O
Algeria	1	0.64	0.41
Egypt	1	0.14	0.02
Iran	1	0.60	0.04
Iraq	1	0.59	0.02
Israel	1	0.44	0.64
Jordan	1	2.00	0.50
Libya	1	1.83	0.25
Morocco	1	0.78	0.41
Saudi Arabia	1	0.79	0.04
Syria	1	0.59	0.03
Tunisia	1	0.83	0.06
Turkey	1	0.44	0.06
Germany	1	0.25	0.37
UK	1	0.30	0.35
USA	1	0.38	0.44

Soil Fertility Evaluation

- Soil Testing
  - Appropriate tests, relationship with plant uptake: correlation
  - Application rates in the field: Calibration
  - Consider nutrient spacial/temporal variability
  - Defining critical nutrients levels in soils
- Plant Analysis
  - Deficiency symptoms
  - Tissue tests
  - Interpretation of results: crop factors

Developments: STC Program

- Dynamic nature of soil P – buildup from fertilization, i.e; residual P.
- Need to consider soil organic matter and influence of N and P mineralization on test values and fertilizer response
- Notion of sustainable use of soils.
- Awareness of spatial variability of nutrients
- Mineralogical influences on nutrient supply/availability.
- Complementary use of plant and soil analyses.
- Awareness of micronutrients, Zn, Fe deficiency, B toxicity.
- Universal soil test for major and micronutrients.
- Standardize soil tests and quality control
- Interaction with mycorrhizae



Integrated Plant Nutrient Systems

What is IPNS?

Optimizing soil fertility and plant nutrient supply from all possible sources of plant nutrients.

Main Objectives

- Soil productivity through a balanced use of mineral fertilizers combined with organic and biological sources of plant nutrients
- Improve and maintain plant nutrients in the soil
- Limit losses to the environment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II-1B
W/F
86-95
W/M


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Imbalanced Fertilization

Survey of Nutrient Use in Syria across Rainfall Zones (200-600 mm)

- Extensive use in irrigated and most rainfed holdings
- Some high mineral N and Olsen P levels indicate excessive nutrient use
- Fertilizers (N.P) used with nutrient-rich municipal wastewater
- Fertilizer application not based on soil tests
- Few farmers listed Extension as information source, only neighbours.

Available Soil Phosphorus Build-Up

Personal Experiences

- High soil P levels in Chaouia, Morocco
- Excess P at experimental stations in Lebanon (AUB, Terbol, Khfardane)
- Increased levels in Tel Hadya Station and Northwest Syria
- Soil P/N in Uzbekistan

Conclusions: *Possible Solutions?*

- Develop Extension System (Formal, Informal)
- Promote Soil Testing and Analytical Facilities
- Install on Farm-Trials in Different Agro-ecological Zones
  - ✓Use soil maps
  - ✓Similar farming practices
  - ✓Test soils at regional level
- Promote Private/Fertilizer Section
- Improve Fertilizer Equipment
- Use Strip Tests (+/- N/P) in Farmers Fields
- Farmer Field Days


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ICARDA
P 40
P 20


ICARDA
0
30
60
90
120
N
150


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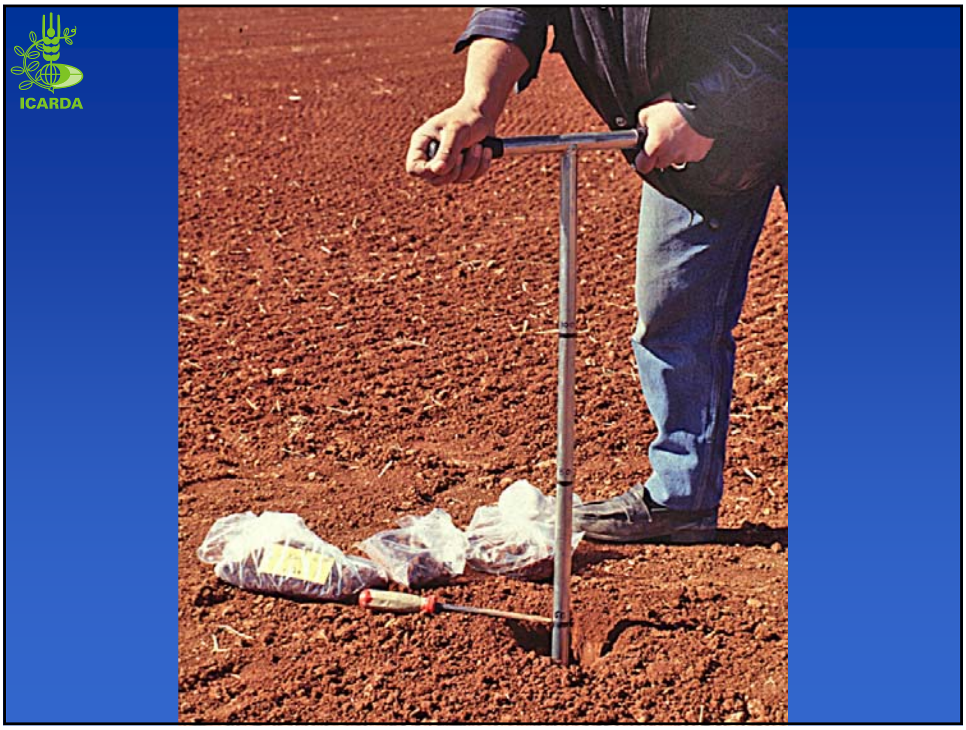
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Future Fertilizer Benificiaries
Thank you