

INCIDENCE, DIAGNOSIS AND MANAGEMENT OF MICRONUTRIENT DEFICIENCIES IN CROPS

SUCCESS STORIES AND LIMITATIONS IN PAKISTAN

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Soils of Pakistan

Soil Orders

- * ARIDISOL
- * ENTISOL
- * INCEPTISOL
- * ALFISOL
- * MOLLISOL
- * VERTISOL

General Properties

- * Alkaline
- * Low OM
- * Generally Calcareous
- * Less Weathered

Source : Rafiq (1996)

Historical Perspective

Zinc Deficiency

- First-ever Micronutrient Deficiency
 - *Hadda* Disease in Rice (Yoshida & Tanaka, 1969)
 - Later Research Established Widespread Zn Deficiency

Boron Deficiency

- Cotton Response to B in Sindh (T M Chaudhry, 1971)

Boron Toxicity ?

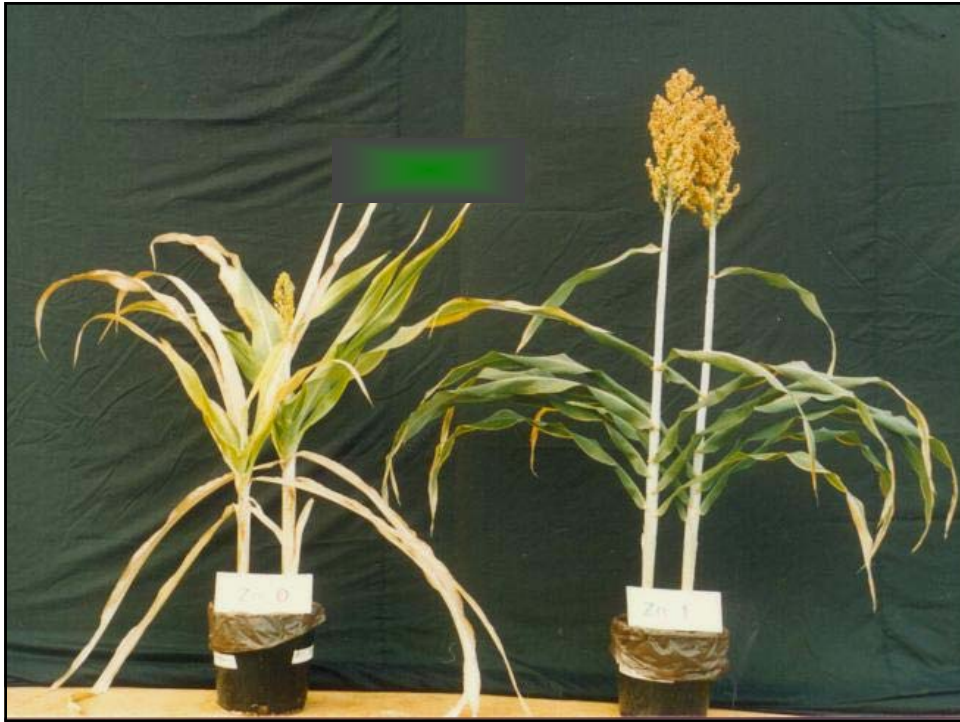
- FAO Global Study on Micronutrients (Sillanpaa, 1982)



Deficient Sites* (%)

Province	Zn	B	Fe
Punjab	46 — 82; 74	50 — 55; 52	Crop-specific; Widespread
NWFP	42 — 66; 60	42 — 69; 60	
Sindh	56 — 76; 71	50 — 53; 51	
Baluchistan	92 — 97; 95	?	

- Cotton-Wheat; Rice-Wheat; Rainfed Crops;
Fruit Orchards; Slightly Acid Soils



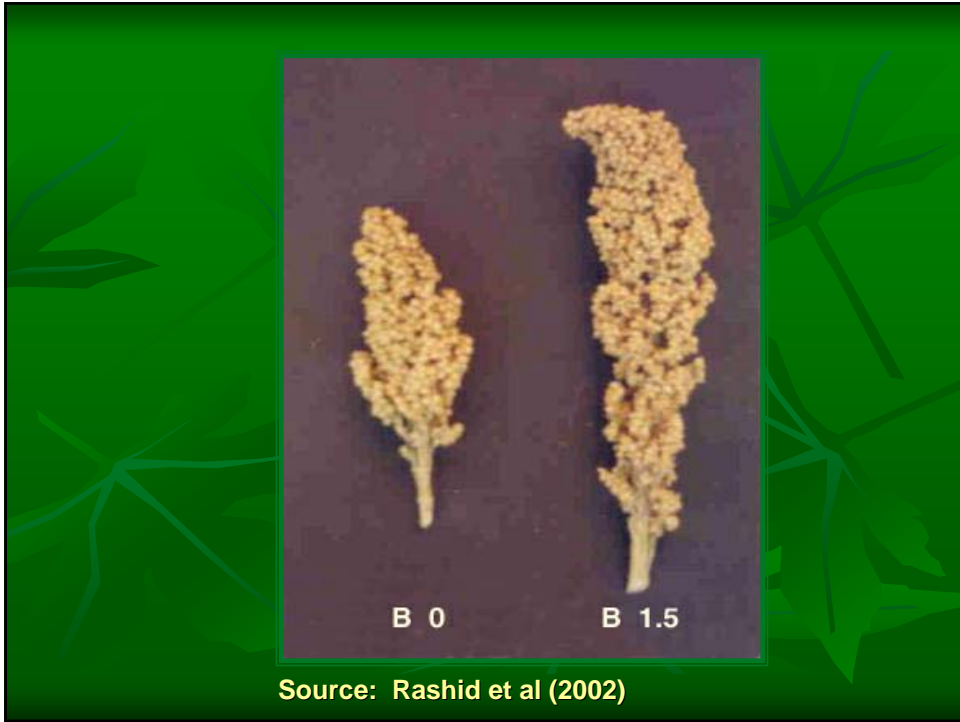
ZINC : Crop Responses & Economics

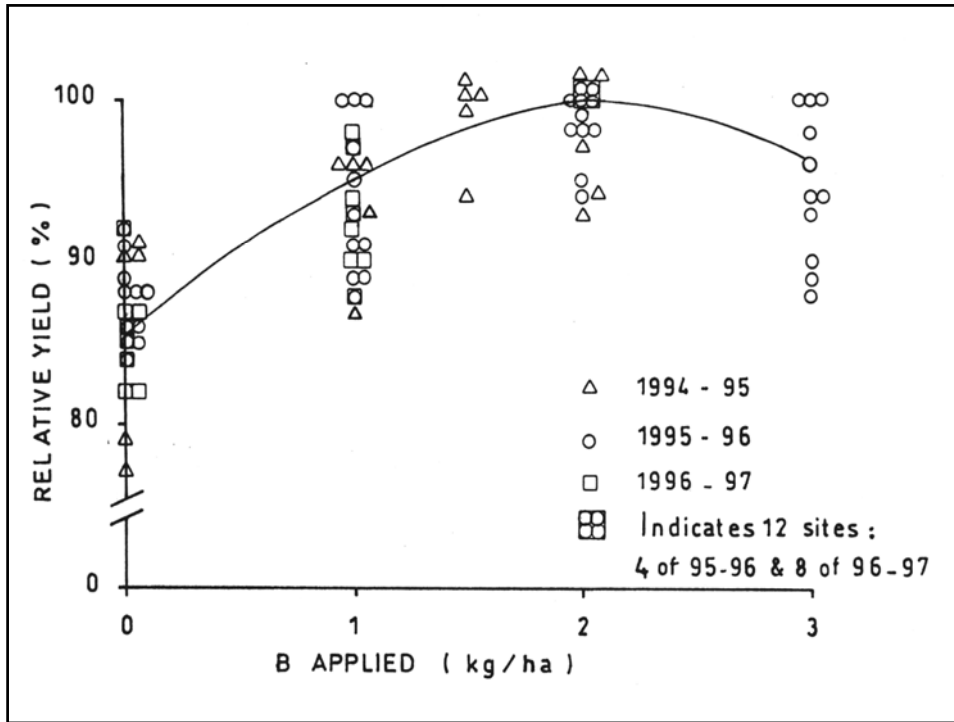
Crop	Control Yield (t/ha)	Yield Increase (%)	VCR*
Rice (Basmati)			
<i>Field</i>	3.08	26	15:1
<i>Nursery</i>	3.08	28	50:1
Cotton	2.26	8	12:1
Potato	16.65	22	52:1
Wheat	3.10	13	7:1
Maize	2.79	18	9:1

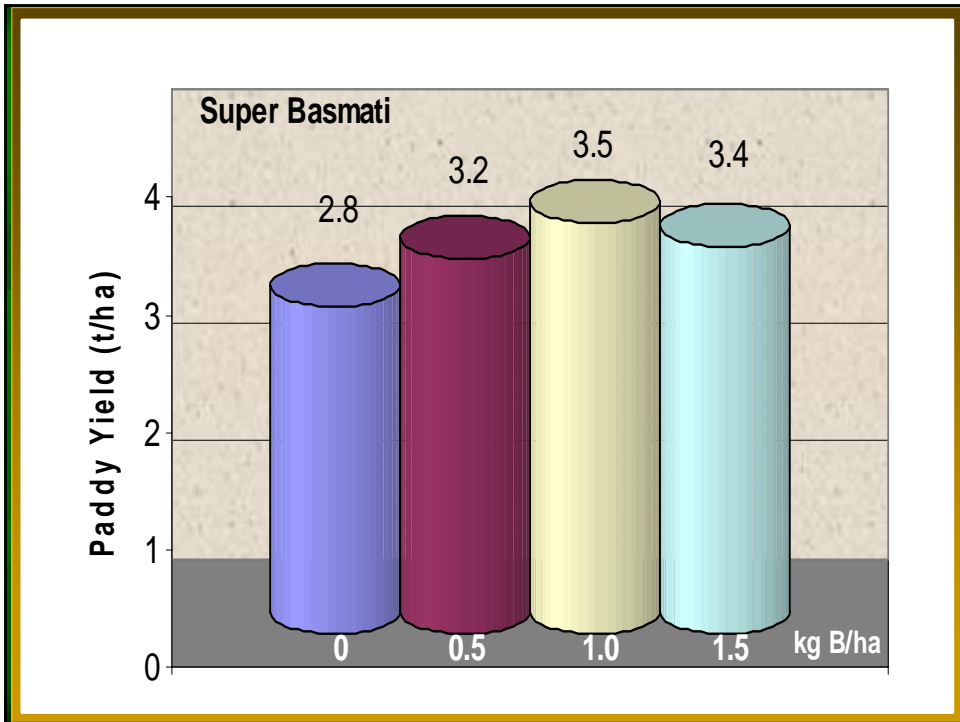
Source: NFDC (1998); NARC (unpublished data)

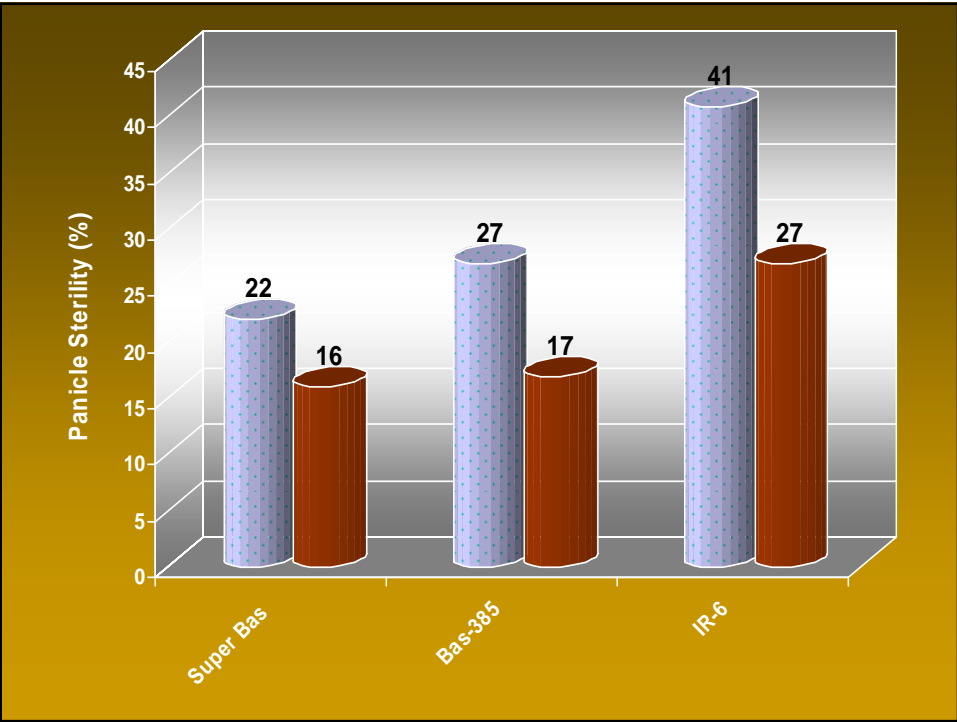
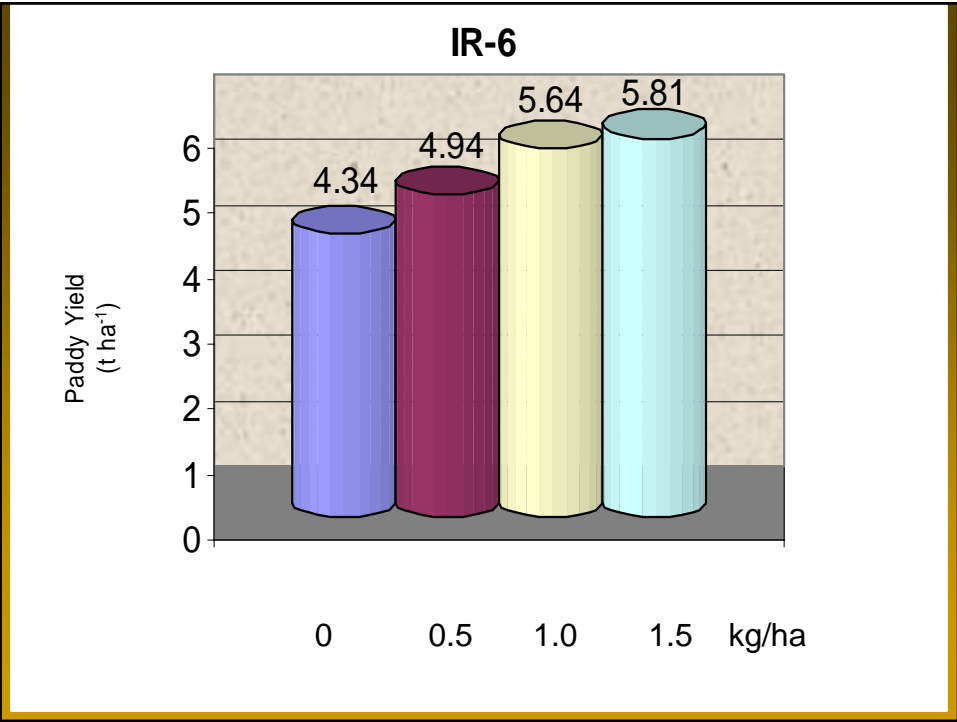


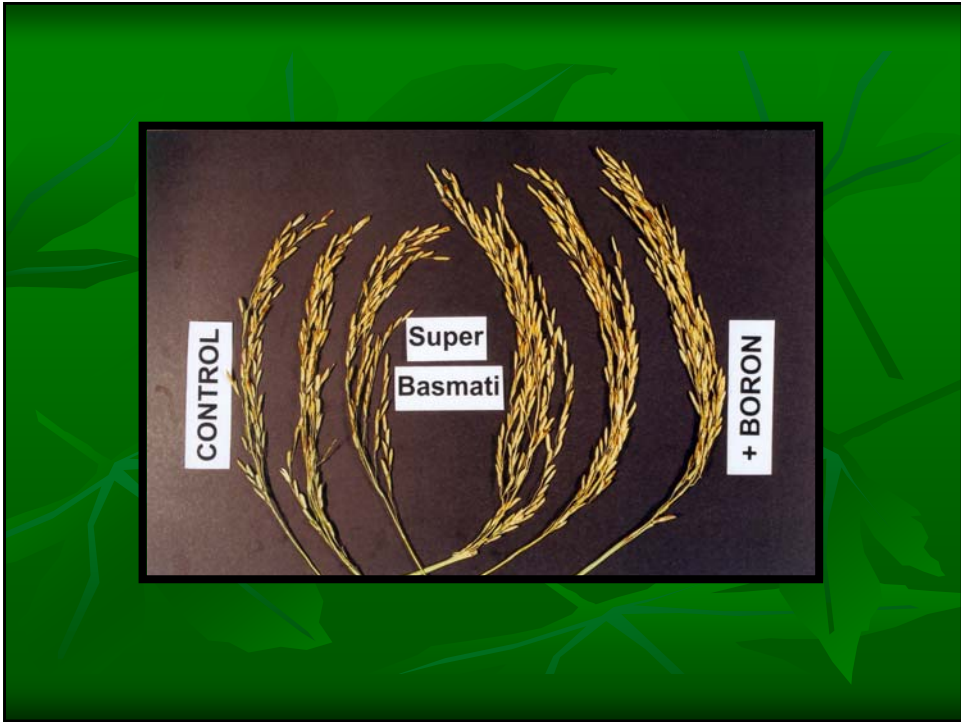
Source: Rashid et al.(2002)













Economics of B Use

■ VCR (Paddy Yield only)

Basmati-385	—	45:1
Super Basmati	—	36:1
KS-282	—	26:1
IR-6	—	30:1

■ Added Advantages:

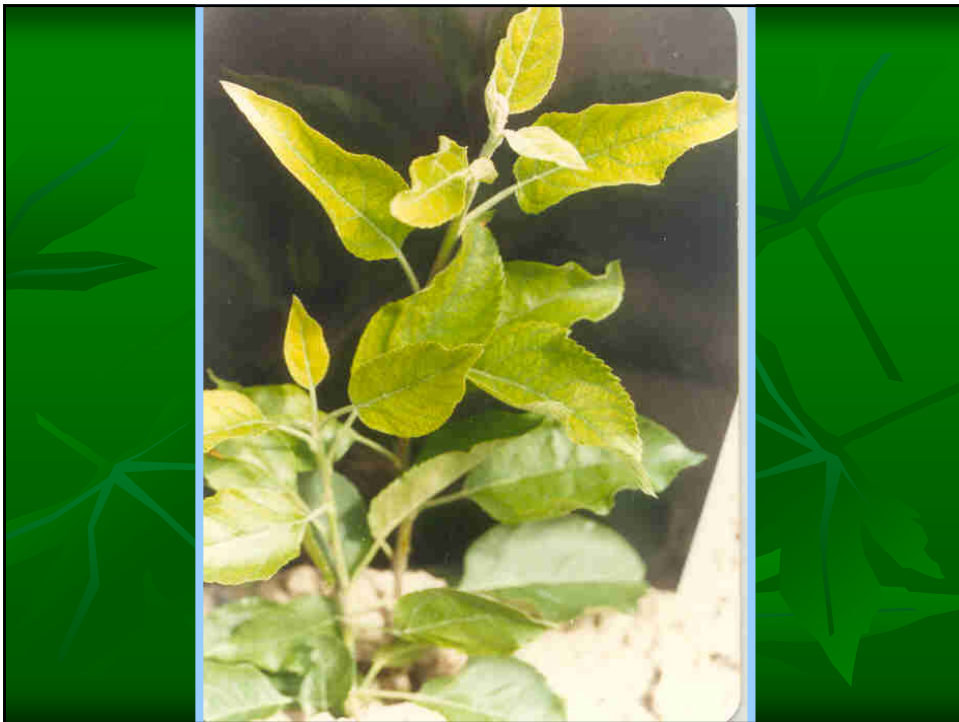
- Milling Return
- Grain Quality
- Residual Effect

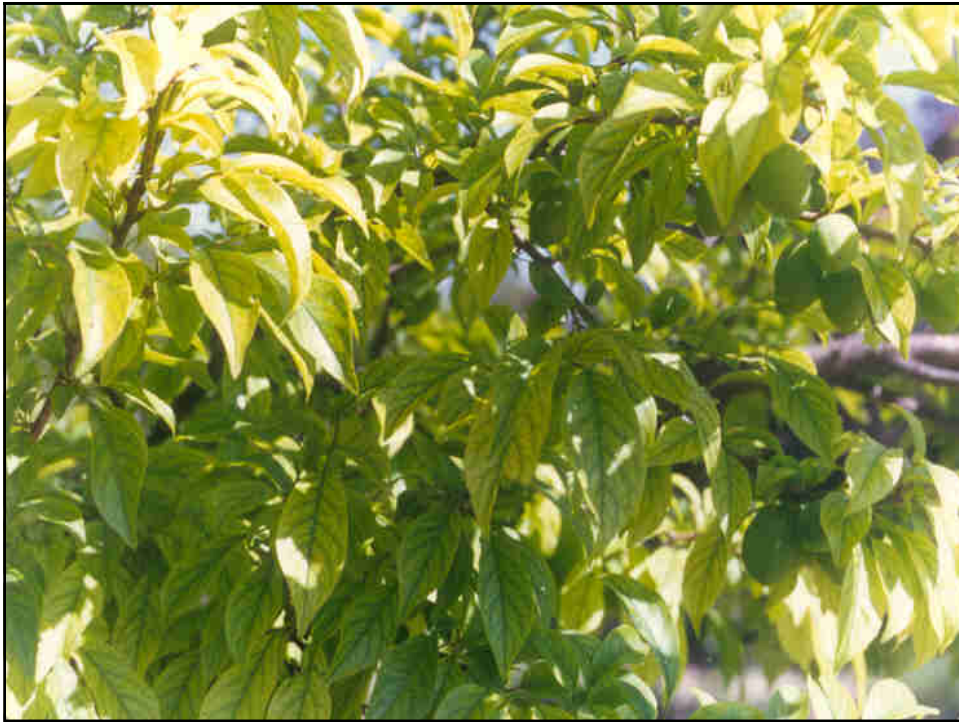
BORON : **Salient Crop Responses**

Crop	Field Expts	Control Yield	Yield Increase	VCR
Cotton		(t/ha)	(%)	
Soil	30	2.38	14	15:1
Foliar	13	2.16	12	30:1
Rice*				
Basmati	32	3.50	15-25	40:1
IR-6	10	4.30	30*	50:1
Wheat	16	3.29	14	8:1
Potato	3	12.11	21	19:1

Source: NFDC (1998); *Rashid et al (2004)









Varietal Susceptibility to Micronutrient Deficiency

Micro-nutrient	Crop	Varieties	
		Susceptible	Tolerant
Zn	Rice	IR-6	Basmati-370
Fe	Chickpea	C-44	CIM-72
B	Rapeseed	CON-II	Westar

Source : NARC, NIAB



Salient Crops Requiring Micronutrient Use

Crops	Zn	B	Fe
Cotton, Rice, Wheat, Maize, Rapeseed, Potato, Tomato, Tobacco, Sunflower, Sugercane	◆	◆	
Deciduous Fruits	◆	◆	◆
Citrus, Beans	◆		◆
Carrot, Radish, Turnip, Cauliflower, Lettuce	?	◆	

Zn & Fe Use Recommendations

Species	Dose & Method
	ZINC
Field Crops & Vegetables	*2 – 5 kg Zn/ha
Rice	20 kg Zn/ha Nursery Area
Fruit Orchards	~3 Foliar Sprays (0.1% Zn Solution)
	IRON
Field Crops & Fruits	3 – 4 Foliar Sprays (0.5% FeSO ₄ OR 1% Sequestrene Solution)
* Lasts 3 – 4 Crop Seasons	

BORON Use Recommendations

Species	Dose & Method
	BORON
Field Crops & Vegetables	0.75 – 1.0 kg B/ha OR 3 Foliar Sprays (0.05 – 0.1% B Solution)
Fruits	2 Sprays (0.05 – 0.75% B Solution)

B & Zn Residual and Cumulative Effect

❖ Experimental Information: Single Crops

	B Uptake	Zn Uptake
Cotton	10–13 %	2 %
Rice	2.6–2.8 %	

❖ Rice-Wheat System: Rice – wheat – Rice (22%) (24%) (13%)

❖ Long-term Research Warranted

Technical Brochure

**MICRONUTRIENTS
IN
PAKISTANI AGRICULTURE**

SIGNIFICANCE AND USE



ADEQUATE MICRONUTRIENT EXTRA PROFIT

NEECPROFIT (Rs. /acre)

NPK NPK + Zn NPK + B

Pakistan Agricultural Research Council
Islamabad
1998

گیاس میں بوران اور زنک کھادوں کا استعمال
اہمیت اور سفارشات

Boron and Zinc Fertilizer Use in Cotton
Importance and Recommendations



پاکستان ایگریکلچرل ریسرچ کونسل، اسلام آباد
2000

Collaboration:
ENGRO ENGRO CHEMICAL PAKISTAN LTD.

دھان میں بوران کھاد کا استعمال
بیواوار اور کواٹی میں تیرت انگیراضافہ

Boron Fertilizer Use in Rice
Substantial Yield and
Grain Quality Improvement



پاکستان ایگریکلچرل ریسرچ کونسل، اسلام آباد
2004

Collaboration:
ENGRO Engro Chemical Pakistan Ltd.

Micronutrient Deficiencies and Health Hazards

Fe & Zn—Poor Feeds & Foods

Adversely Affect
Animal and Human Health

Source: Miller et al. (1991); Graham and Welch (2000); Rashid et al. (2002)

Human Zn Deficiency in Pakistan

	n	Deficient (%) (< 60 mg/dL)
Children (< 5 Yr)		
Male	5,369	36
Female	4,804	38
Women		
Pregnant	1,392	49
Non-Pregnant	8,612	40

Source: National Nutrition Survey, GoP (2002)

Curing Zn and Fe Deficiencies in Humans and Animals

- Mineral Supplements
- Intramuscular Injections

Remedial Measure

- Biofortification thru Micronutrient Fertilization
- Zn & Fe in Feedstuffs Increases – with Little Effect on Bioavailability.
- The Option is Simple and Highly Cost-Effective.

Source: Graham & Welch (2000); Rashid et al (2002)

Micronutrient Use in Pakistan

■ Potential Requirement

Zn 5,700 t

B 2,800 t

Fe 290 t FeSO_4 + 525 t *Sequestrene*

- **Actual Use:** Inadequate - Rice, Potato, Cotton, Citrus, Apple, etc.
- Crops Suffer Yield Losses & End Up as Micronutrient-Poor Feed- and Food-Stuffs

Source: NFDC (1998)

Constraints to Micronutrient Use

- ✿ Stakeholders' Ignorance
- ✿ Inadequate Fertilizer Availability
- ✿ Dubious Quality
- ✿ Application Problems
 - Uniform Field Application
 - Mixing with Fertilizers
 - Spray Solution Preparation

In – Summary

- Micronutrient Deficiencies lead to Productivity Loss, Quality Deterioration & Health Hazards.
- Problems are likely to Accentuate over Time.
- Micronutrient Use is Highly Cost-Effective but Remains Negligible
- Remedial Measures: (i) Enhanced Awareness; (ii) Improved Fertilizer Availability; (iii) Micronutrient-fortified Fertilizers; (iv) Quality Control.