Overview of FAO/IAEA Coordinated Research Project on Crop genotypes Tolerant to low N and P Soils

Joseph Adu-Gyamfi and Gerd Dercon

FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, International Atomic Energy Agency, Vienna, Austria

23 July 2012

IAEA

Joint FAO/IAEA Programme

Nuclear Techniques in Food and Agriculture

The Presentation

Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Introduction

- The CRP, Objectives, Contract Holders and Framework and Research Coordination Meetings

Root Traits for N and P acquisition and utilization

- P in common bean and maize
- N in maize

Mechanisms of crop adaptation to low N and P

-

Results and Conclusions

Approaches to Increasing Crop Productivity in Harsh Environments

Development of innovative land (soil-plant-water) management that enhances the adaptability of crops

Integration

Identify crop plants (species and varieties) with superior root characteristics that better utilize soil water and nutrient resources

Improving Soil conditions for plant growth

Adapting plants to existing soil conditions

IAEA

Joint FAO/IAEA Programme

Nuclear Techniques in Food and Agriculture

Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Objectives

- Develop and validate screening protocols for plant traits that enhance N and P acquisition
- Employ screening protocols to identify genotypes with superior N and P acquisition and/or utilization.
- Assess the productivity of the selected genotypes on cropping system performance

The CRP (2006-2011)

Research Contract Holders (9)

- Burkina Faso
- Brazil
- Cameroon
- China
- Cuba
- Ghana
- Malaysia
- Mexico
- Mozambique

Agreement Holders (5)

- Australia
- Benin
- Germany
- Kenya
- Nigeria
- France

Technical Contract Holder (1)

- United States of America

Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Framework for the CRP

Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Strategy

Rapid Screening (150-200 genotypes)

Lab (paper rolls)
Greenhouse (small pots)

Evaluation (15-30 genotypes)

Field evaluation
Greenhouse (Large pots)

Adaptation Mechanisms (3-10 genotypes

P acquisition from different soil P pools using ^{32}P

2006-2008

2009-2010

2011 Data Processing , interpretation and manuscript preparation

Cigar roll

Field Root Crown sampling

Mechanisms

Research Coordination Meetings

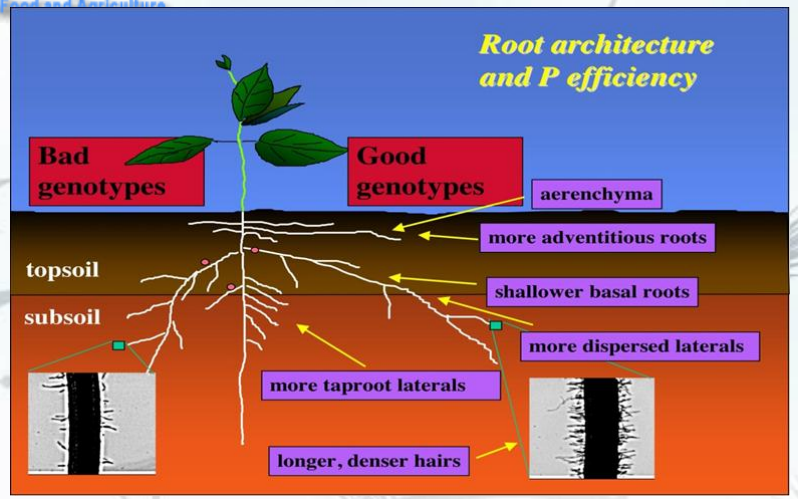
1st RCM, Vienna, 2006

3rd RCM, Maputo MOZ, 2010

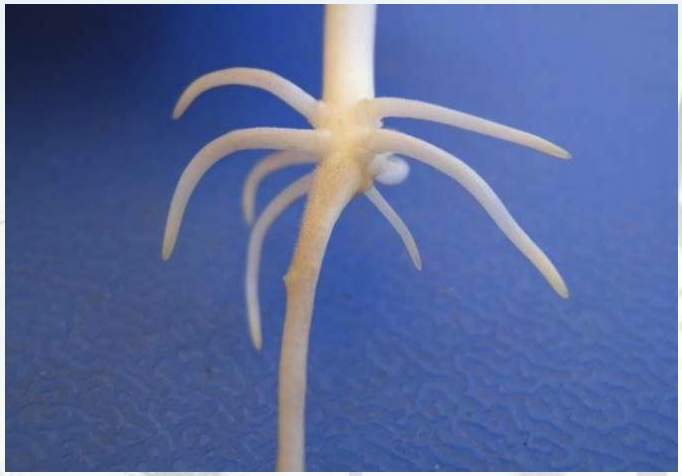
2nd RCM, Morelia, Mexico, 2008

4th RCM, Vienna, 2011

Root Traits for P Efficiency by legumes

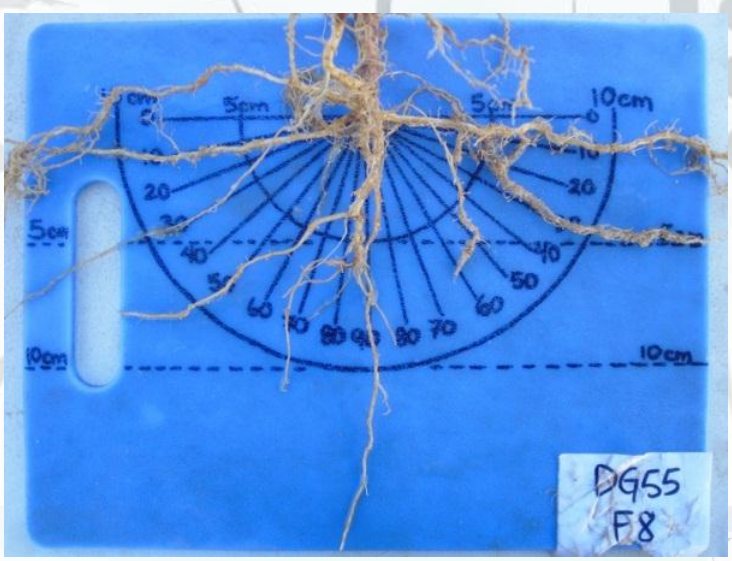


Root Architecture



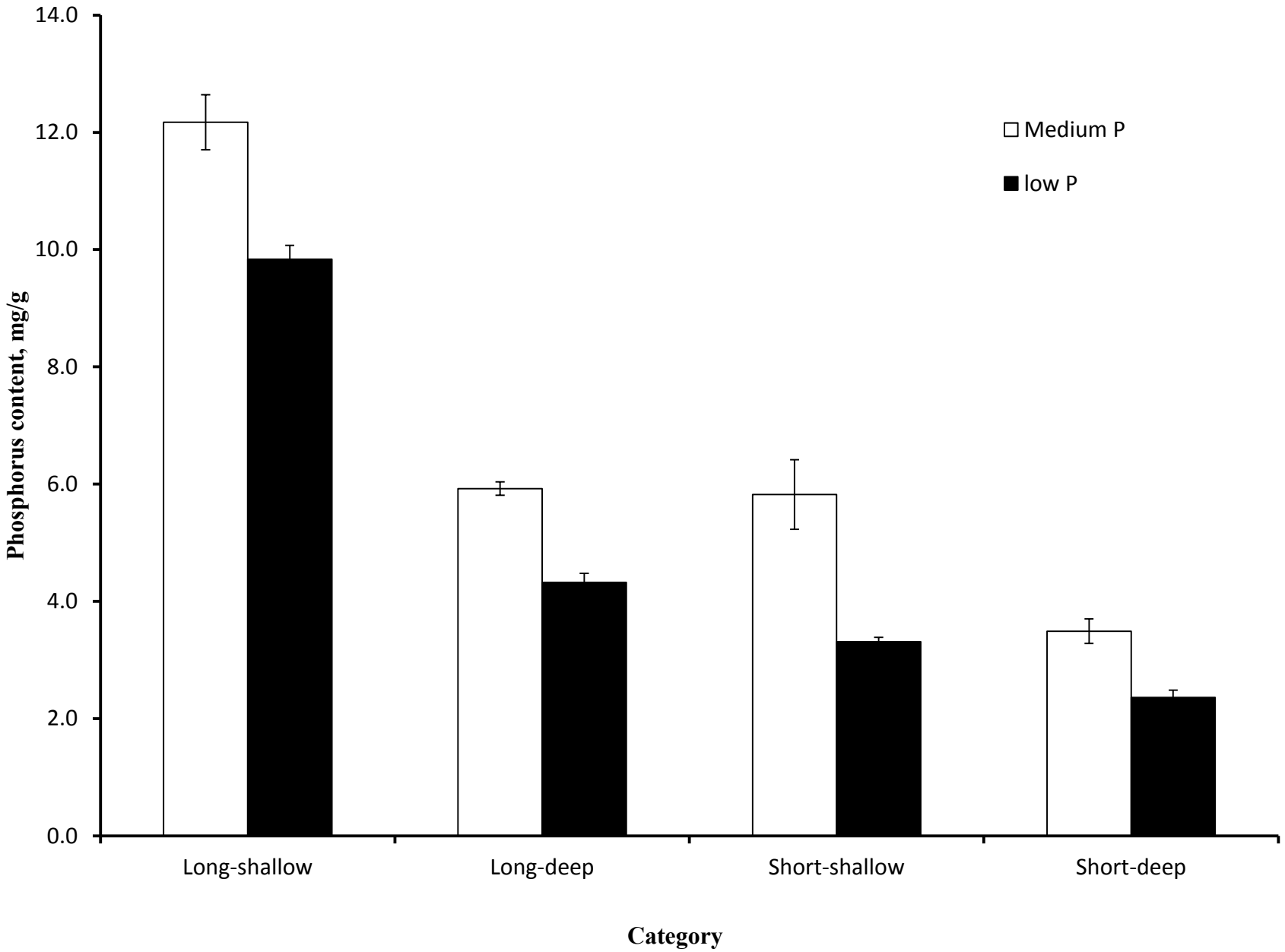
Basal Root Whorls Number (BRWN)

Root Hairs



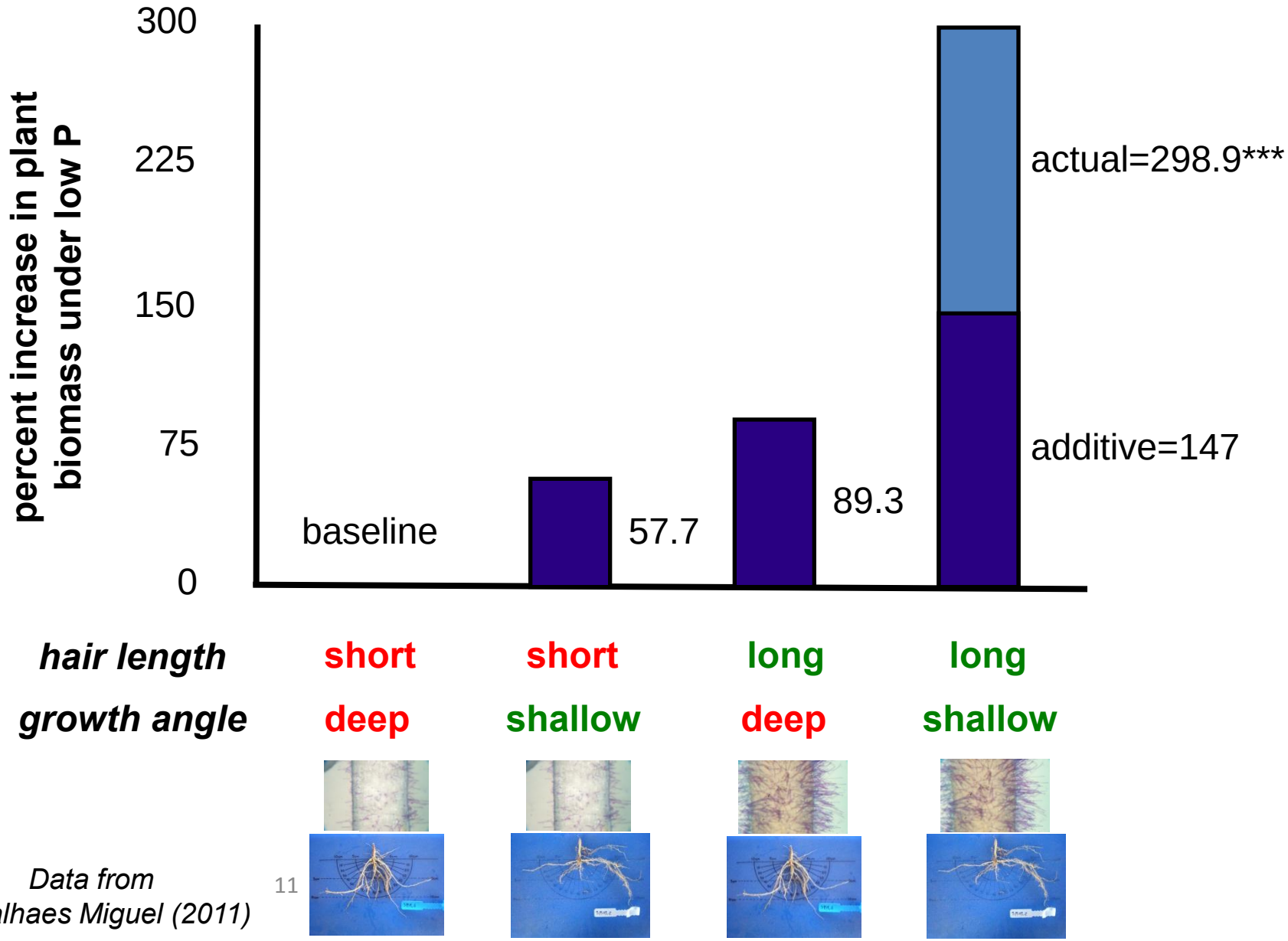
Basal Root Growth Angle (BRGA)

Root Traits and P acquisition



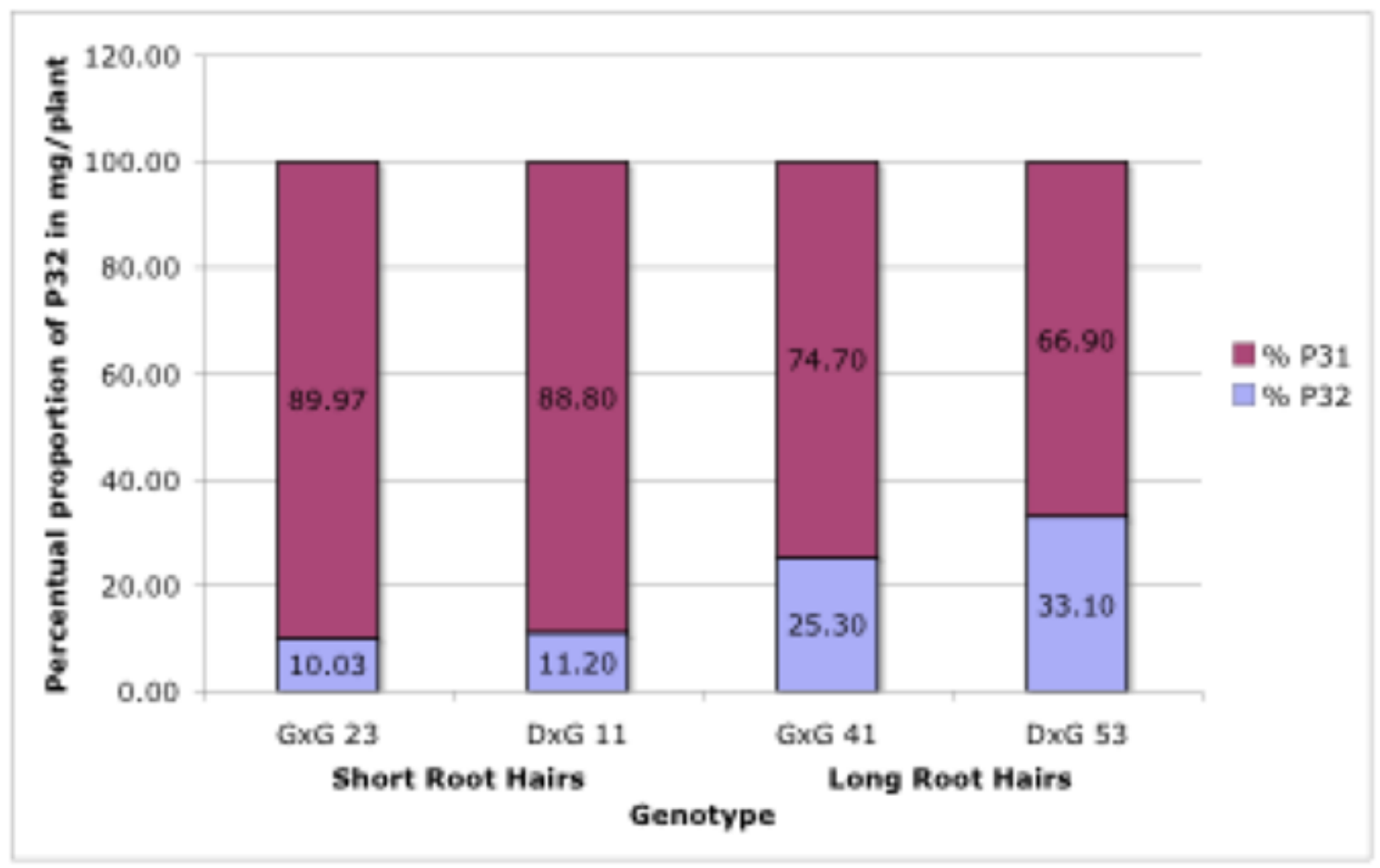
phene synergism for P acquisition

3 RILs per phenotype, field study in low P soil in Mozambique



Data from Magalhaes Miguel (2011)

Up to 30% of P in plant tissue can be absorbed by root hairs



FIAT PANIS

IAEA

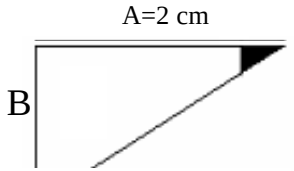
Joint FAO/IAEA Programme

Nuclear Techniques in Food and Agriculture

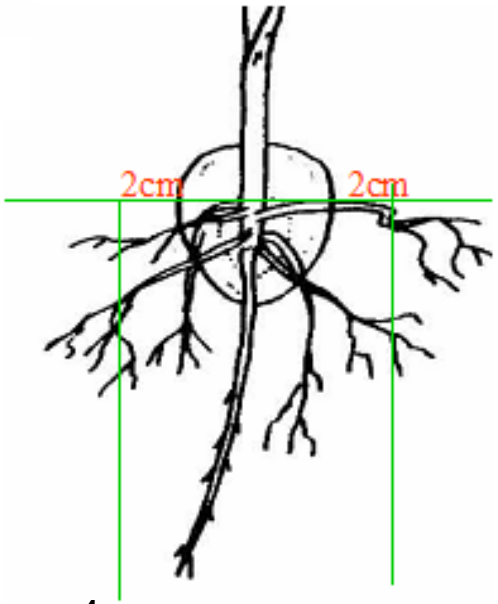
Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

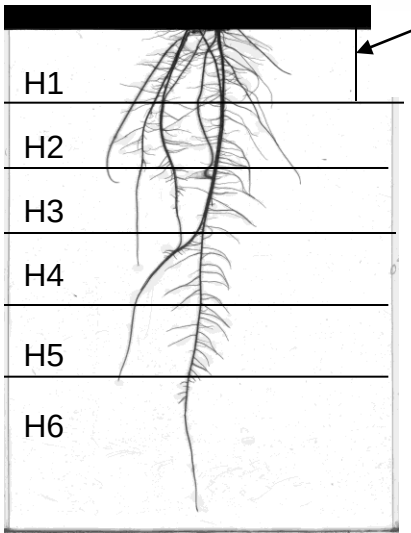
Root traits contributing to enhanced acquisition of N from low N soils by maize

Estimating root traits with enhanced N acquisition by maize in a field experiment



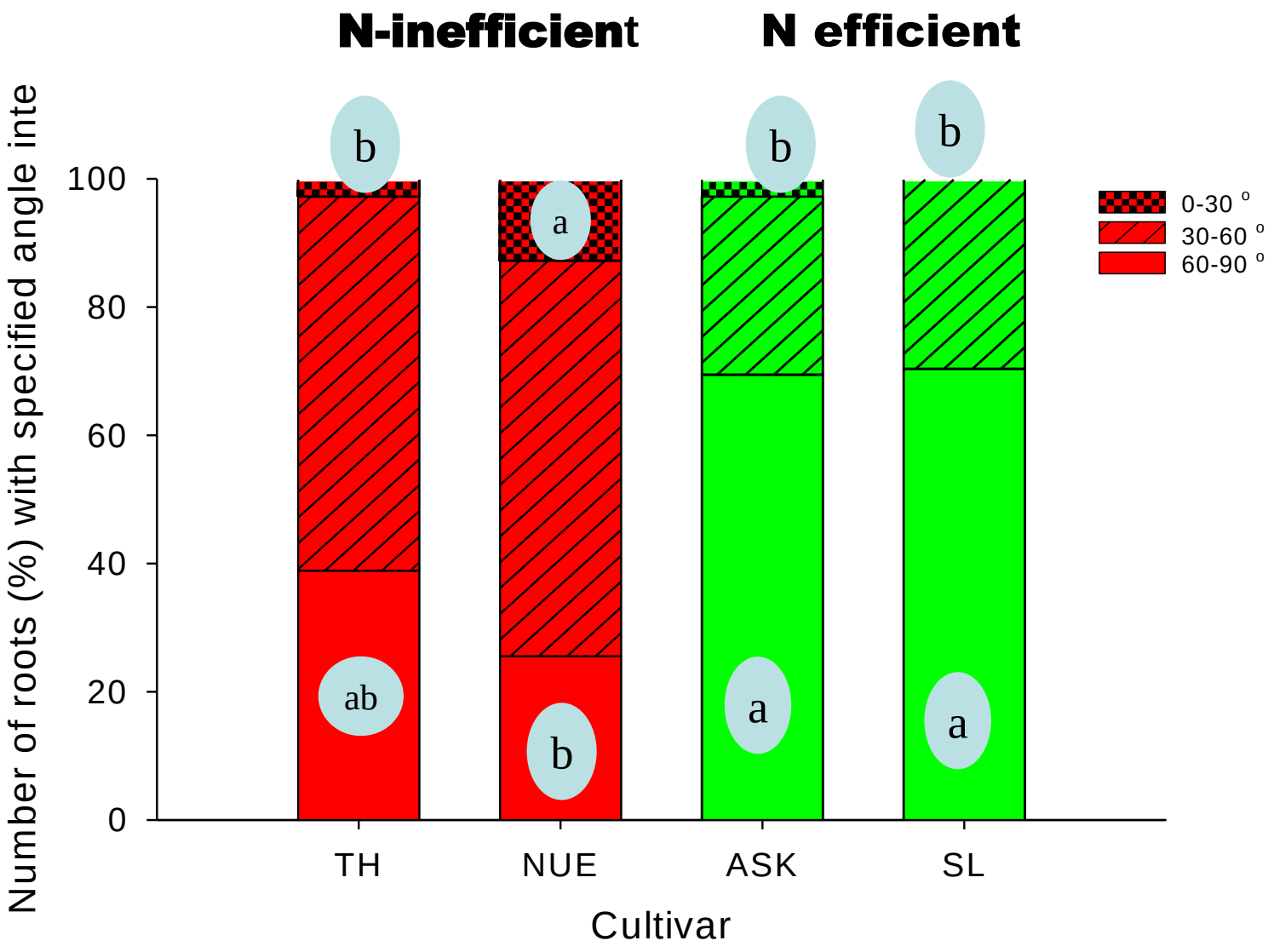
$\tan \theta = B/A$





Measuring Root Branching Angle

Specified branching angle of 4 temperate maize cultivars grown at low N (100 μM N)



From W Horst

CONCLUSIONS

Branching angle interval was identified as a suitable root selection parameter for soil N use efficiency

Adventitious rooting and root hair formation were identified as suitable plant parameters for selecting P use efficiency

Protocols for characterization of root traits contributing to enhanced phosphorus acquisition developed are available on http://www.naweb.iaea.org/nafa/swmn/index.hmtl


IAEA
Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Thank you