Azolla fertilizer as an alternative N source for red spinach production on alluvial and peat soils in West Kalimantan, Indonesia

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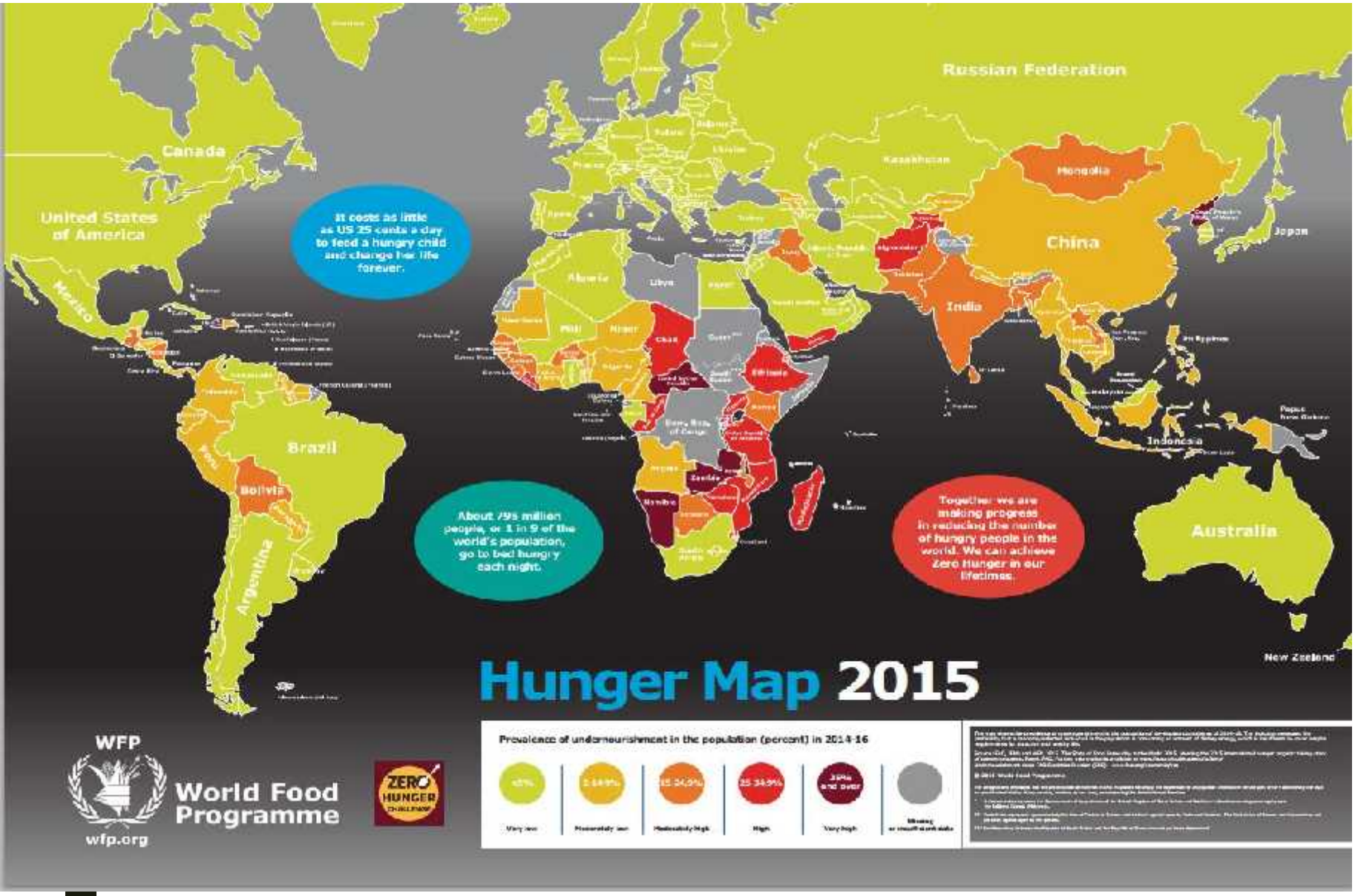


http://adesojiadegbulu.com/hunger-map-2015/

http://www.rappler.com/move-ph/issues/hunger96163-united-nations-acute-malnutrition-indicator-sdg

Introduction

- Food security in Indonesia
- Sustainable Reserve Food Garden Program
- Locally-grown fertilizer

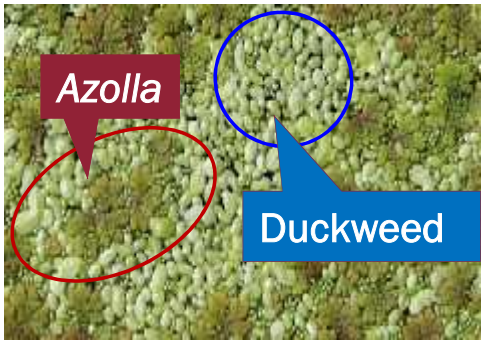
❖**The contributions of *A. pinnata* as a biofertilizer on red spinach production on Inceptisols and Histosols in West Kalimantan, Indonesia**

Azolla pinnata

http://www.hear.org/pier/imagepages/singles/azospp11.htm

2.5 cm

https://azollablora.wordpress.com/2013/11/16/berbagai-manfaat-azolla/



http://bharatnamaskar.blogspot.com/2012/07/super-plants-solution-to-food-water.html

Azolla utilization

Waste water treatment


http://www.folkecenter.net

Animal feed

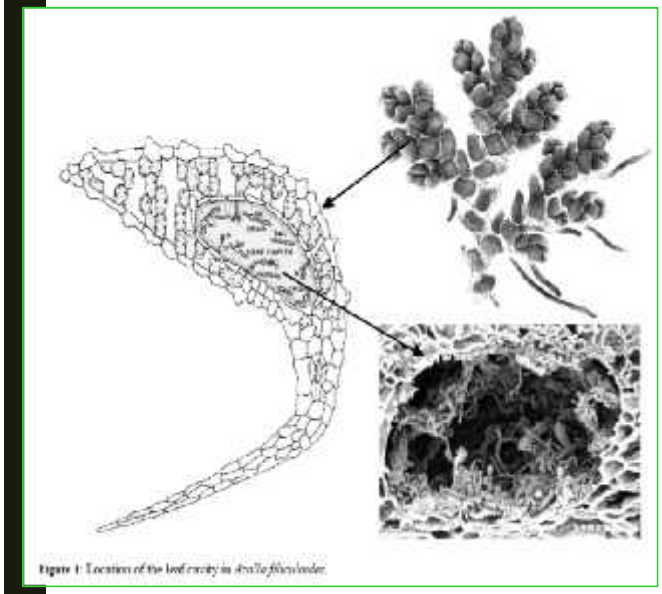

http://theazollafoundation.org

Food



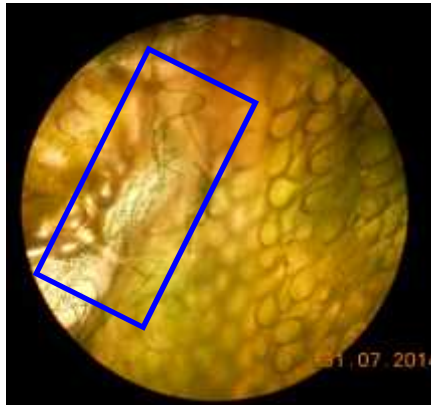
http://www.eriksjodin.net

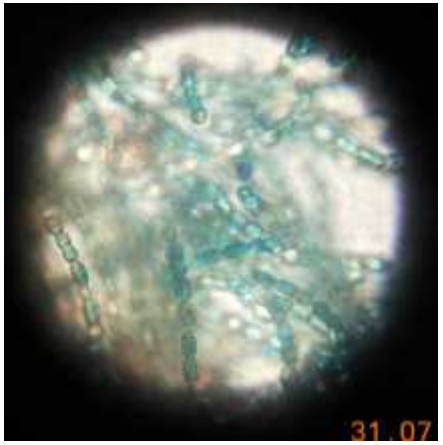
Biological nitrogen fixation

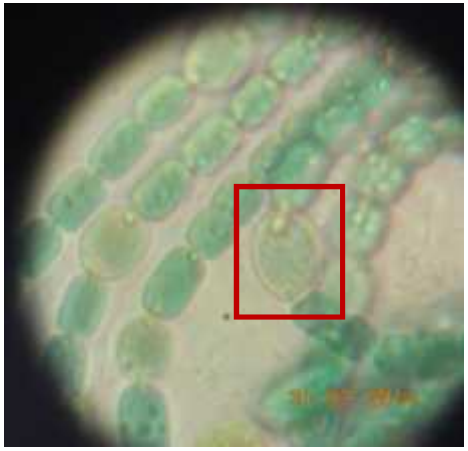


https://www.researchgate.net/profile/Francisco_Carrapico

Anabaena azollae* inside the leaf cavities *of Azolla mexicana







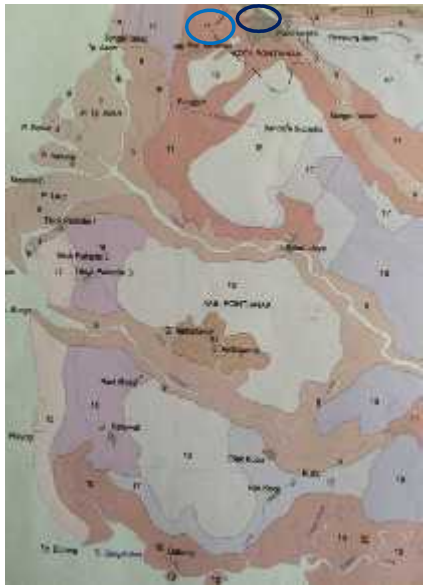
Study site

- ✓Agricultural Research Station and local farmer, West Kalimantan, Indonesia

- ✓Sulfic Endoaquepts and Terric Sulfihemists

- ✓Tropical moist climate (IIIC and IVC)
  - average T > 18 °C
  - average RH 80.8%
  - annual precipitation 2000-4000 mm

http://www.worldmap1.com



Indonesian Soil Research Institute, 2004

Methods

✓Randomized Complete Block Design, 3 replicates

✓Treatments:

- control
- urea at 50 kg ha^{-1}: ~ 23 kg N ha^{-1}
- chicken manure at 5 t ha^{-1} (3.19% N): ~ 108 kg N ha^{-1}
- *Azolla* at the urea N rate (2.88% N): ~ 23 kg N ha^{-1}
- *Azolla* at the manure N rate (~ 108 kg N ha^{-1})

Materials and methods

✓Spinach: Red “Giti” Spinach
(Indonesian Vegetable Research Institute)

✓ Fertilizer application:
- Plant ash: 3 t ha^{-1} (peat)
- Manure and *Azolla*: 3 DAT
- Urea: 3 and 14 DAT

✓ Harvesting at 45 days

Methods: Growing *Azolla pinnata*

- ✓ T ≤ 30 ^{o}C and not too much high light intensity
- ✓ Inoculation rate: 100-200 g m^{-2}
- ✓ Plant ash: 0.75 t ha^{-1} (peat)
- ✓ *Azolla* harvested at 3-4 weeks

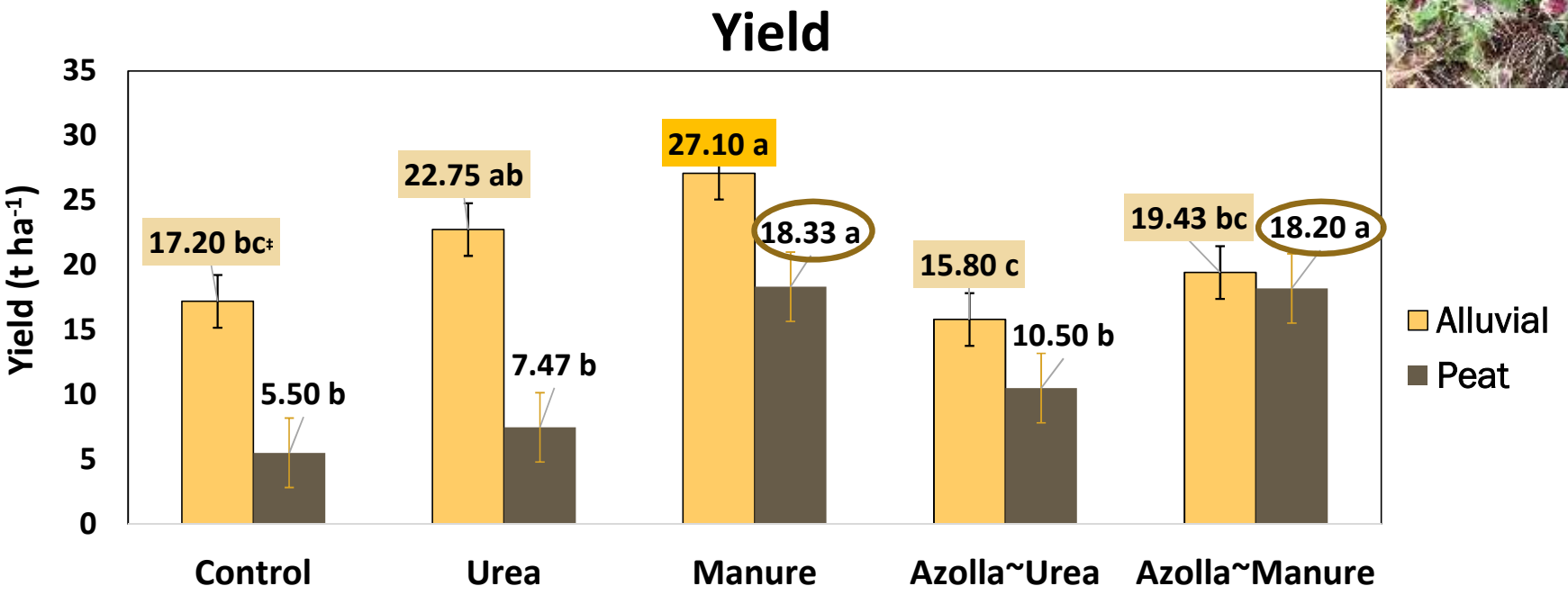
Data collection and analysis

Agronomic parameters:

- Yield
- Plant height
- Leaf and branch numbers
- Leaf N content
- Nitrogen use efficiency (NUE)

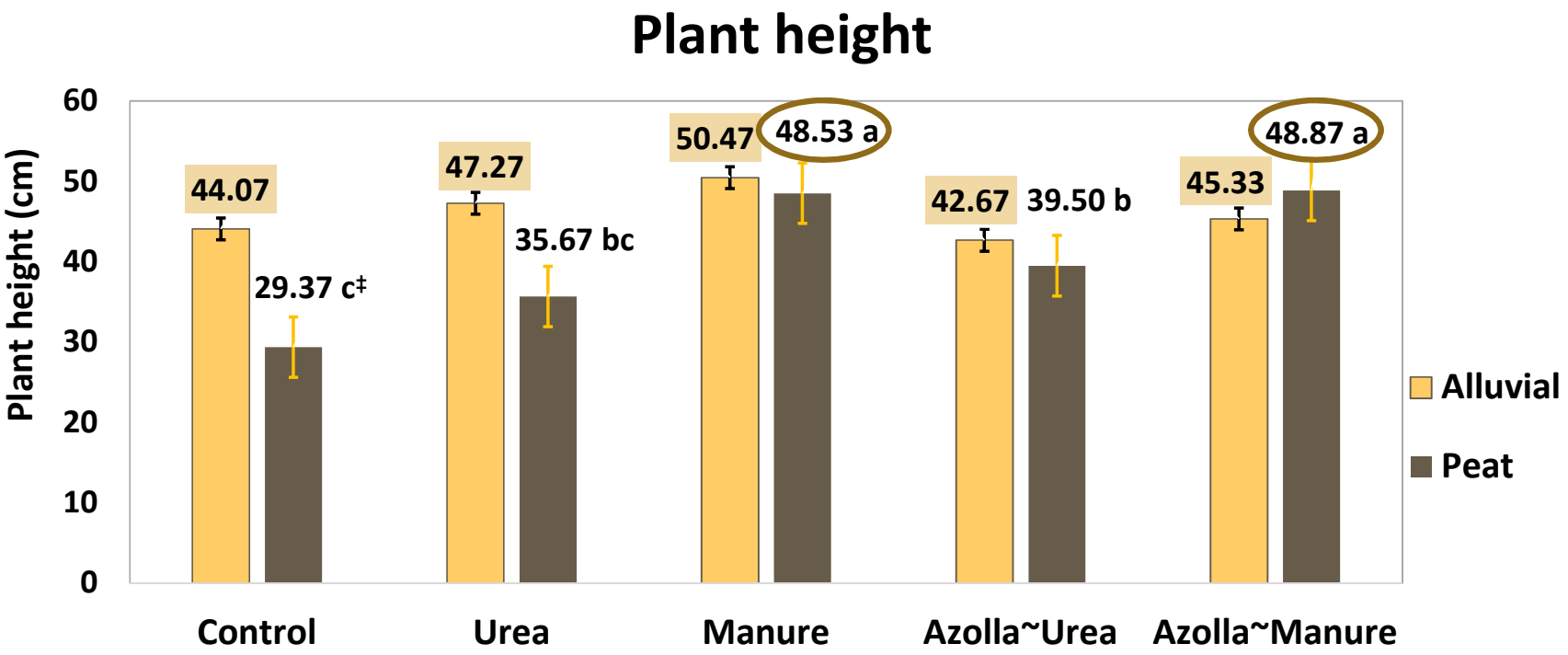
Data analysis using SAS 9.4

Results



†Values followed by a different letter indicate significance difference within the same soil based on Tukey's HSD test ($p<0.10$)

Results



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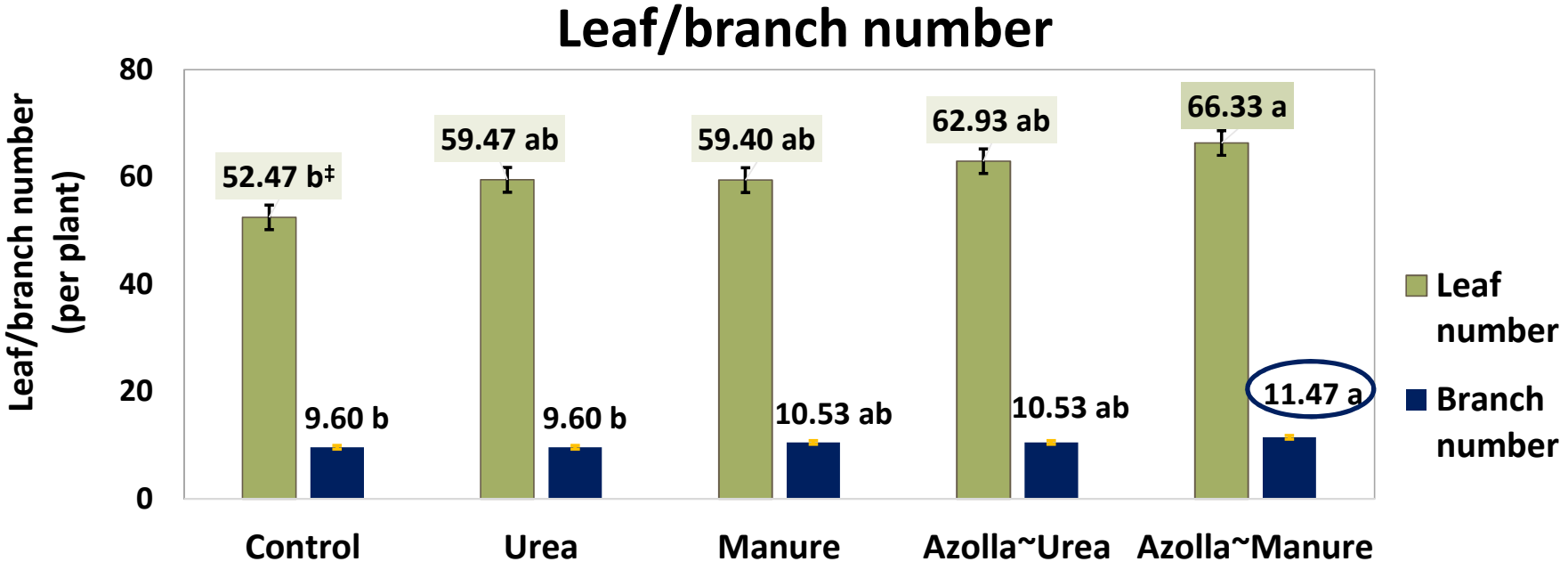
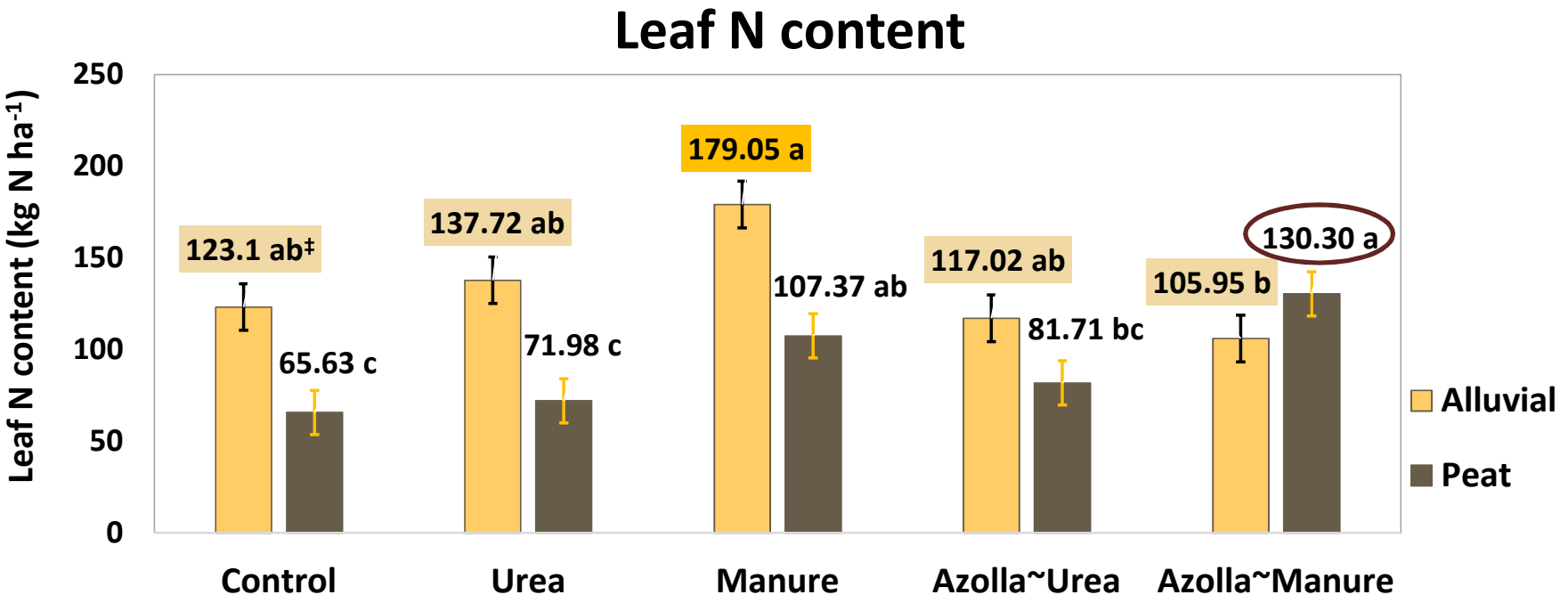
Results



†Values followed by a different letter indicate significance difference within the peat soil based on Tukey's HSD test ($p<0.10$)

Results



†Values followed by a different letter indicate significance difference within the same soil based on Tukey's HSD test ($p<0.10$)

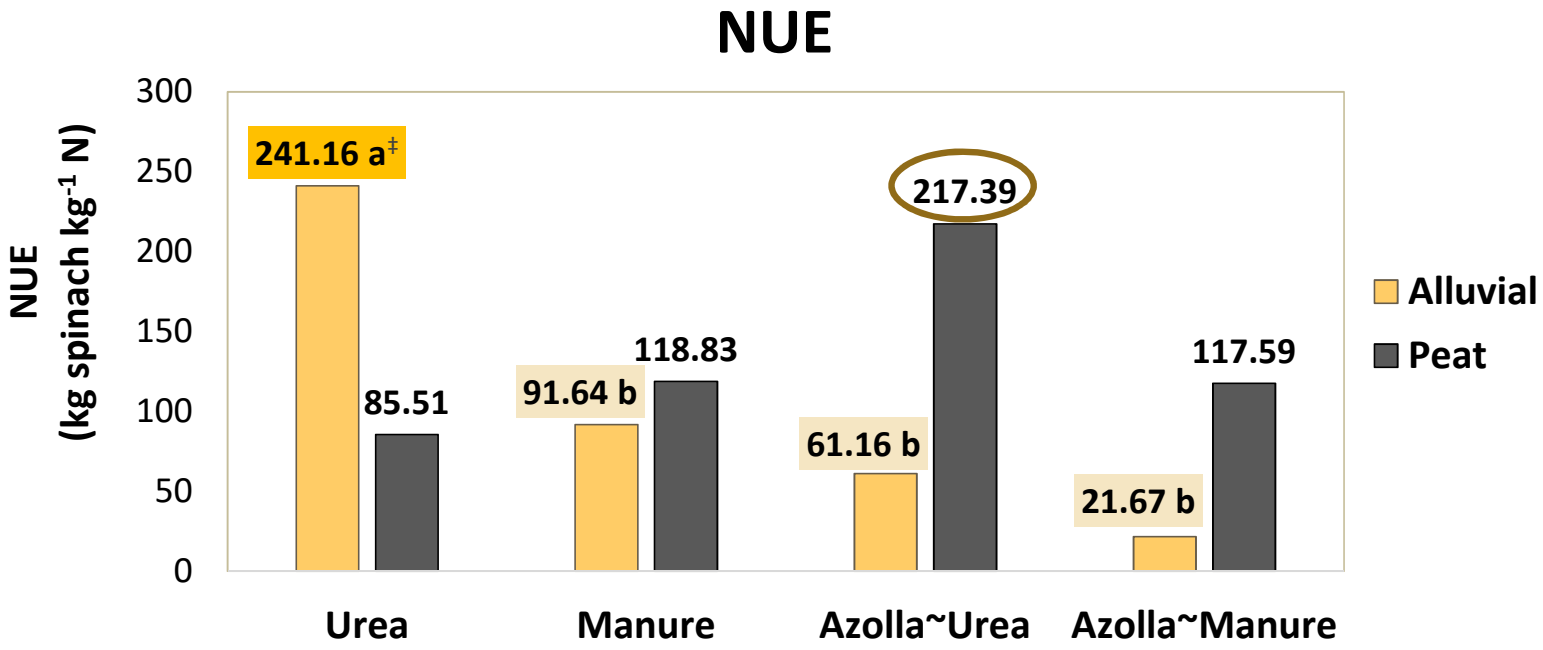
Nitrogen use efficiency

(Dobermann, 2005):

- **Agronomic efficiency of applied N = $(Y_N - Y_0)/F_N$**

Y_0 = yield in unfertilized N plot (kg)
Y_N = yield in N plot (kg)
F_N = kg N applied

Results



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Conclusions

- ✓ The agronomic parameters on the alluvial soil are relatively higher.
- ✓ Yield and leaf N content respond to fertilizer treatment.
- ✓ Urea showed significantly highest NUE on the Alluvial soil and *Azolla*~Urea on the peat soil.
- ✓ *Azolla* applied at the manure N rate can be used as an alternative biofertilizer, especially for peat soil.

Acknowledgements

- Sustainable Management of Agricultural Research and Technology Disseminations (SMARTD)-Indonesian Agency for Agricultural Research and Development (IAARD)-Ministry of Agriculture, Republic of Indonesia
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- Subroto-local farmer in Siantan, West Kalimantan, Indonesia


Thank You