Integrated Soil Fertility Management: Lessons from Africa

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Funding: NSF, NSERC

Research Paradigm Shifts

- 1960's and 1970's
  - External inputs
    - Minor achievements; land degradation; abolition of fertilizer subsidies
- 1980's
  - Low mineral input sustainable agriculture
    - Lack of sufficient organic resources; labour intensive; nutrient imbalances
- 1990's
  - Integrated soil fertility management

Integrated Soil Fertility Management

- Combined use of fertilizer and residue inputs

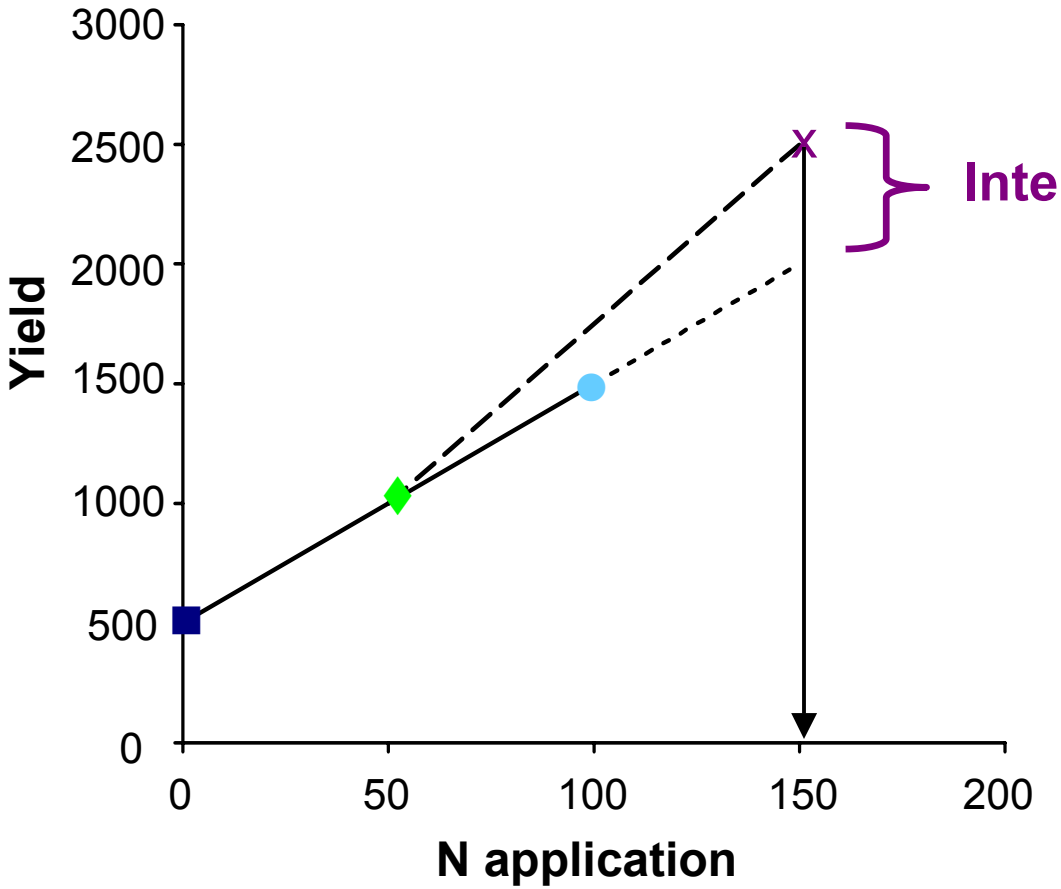
- Neither available or affordable in sufficient quantities
- Hypotheses for **interactive effects**
  - Extra crop yield
  - Improved soil fertility status
  - Reduced losses of nutrients to the environment

Interactive Effects - Hypotheses

- Direct: Temporary immobilization of applied fertilizer N may improve N synchrony.
  - Improve N supply

- Indirect: Organic matter-related improvement in soil conditions may lead to better plant growth.
  - Improve N demand

Interactive Effects - Concept



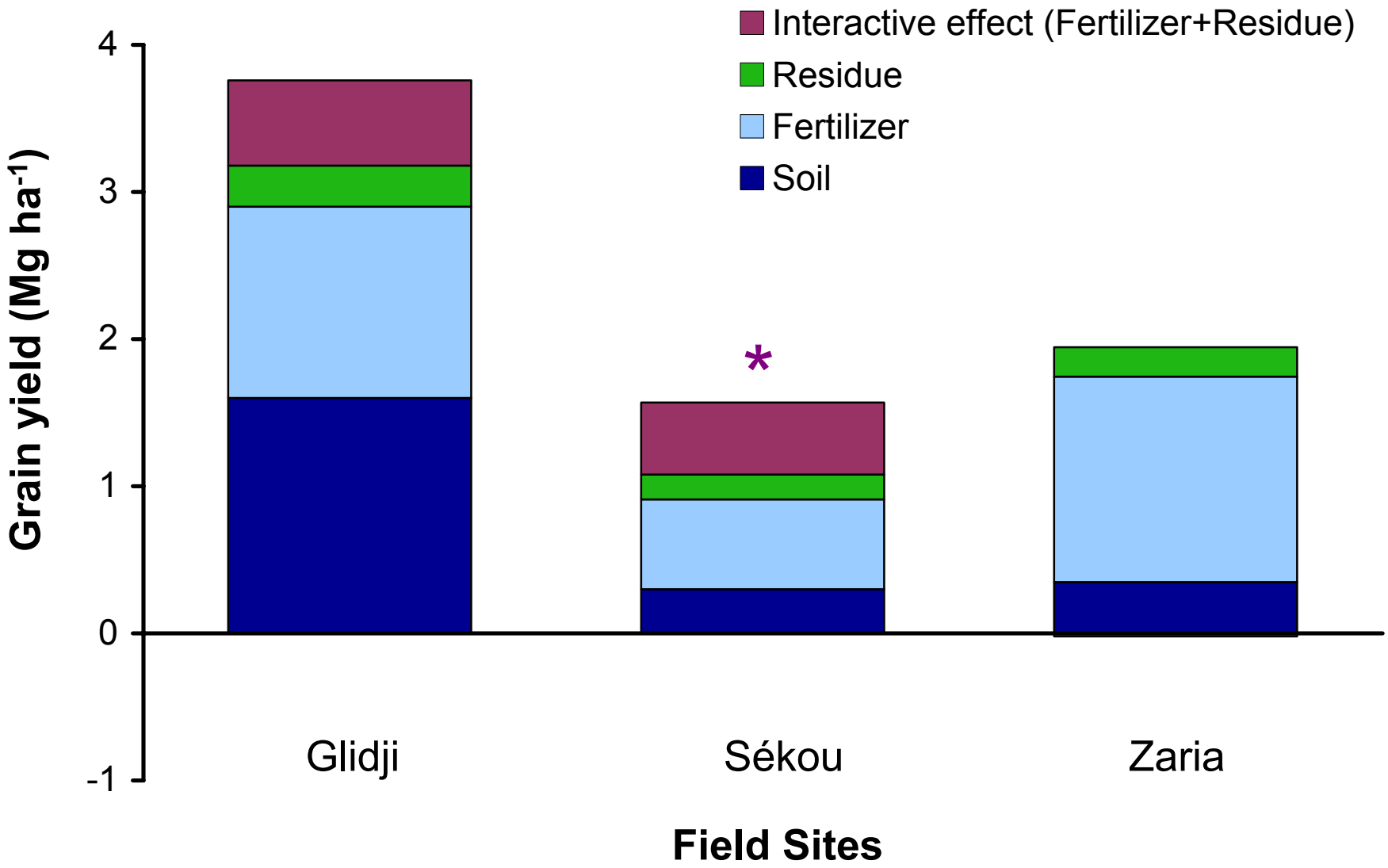
	Input	Yield
■	Soil	500
♦	Residue	1000
●	Fertilizer	1500
x	Fertilizer+Residue	2500

Interaction = Fertilizer+Residue - Soil - (Fertilizer - Soil) - (Residue - Soil)

Interaction = 2500 - 500 - (1500 - 500) - (1000 - 500)

Interaction = 500

Interactive Effects - Yield Example



(Vanlauwe et al. 2001)

Research Objectives

- Examine the interaction of combining fertilizer and residue inputs on N and C cycling

- Determine how this interaction varies across soil textures and climates

Experimental Design

- Ecozones (3)
  - Kenya, Zimbabwe, Ghana
- Soil textures (2 per ecozone)
  - fine, coarse
- Organic residue quality (4)
  - Control (no input), *Tithonia*, *Calliandra*, maize stover
- Fertilizer N input (2)
  - 0 and 120 kg N ha^{-1}

Experimental Design

- Microcosm
  - Controlled environment conditions
  - $^{15}N/^{13}C$ labelled inputs
  - Gas losses, mineral N, soil aggregate fractions
- Microplot
  - $^{15}N/^{13}C$ labelled inputs
  - Gas losses, N leaching, soil aggregate fractions
- Field
  - Sampling after 4 years of treatments
  - Soil aggregate fractions, yield, plant N uptake

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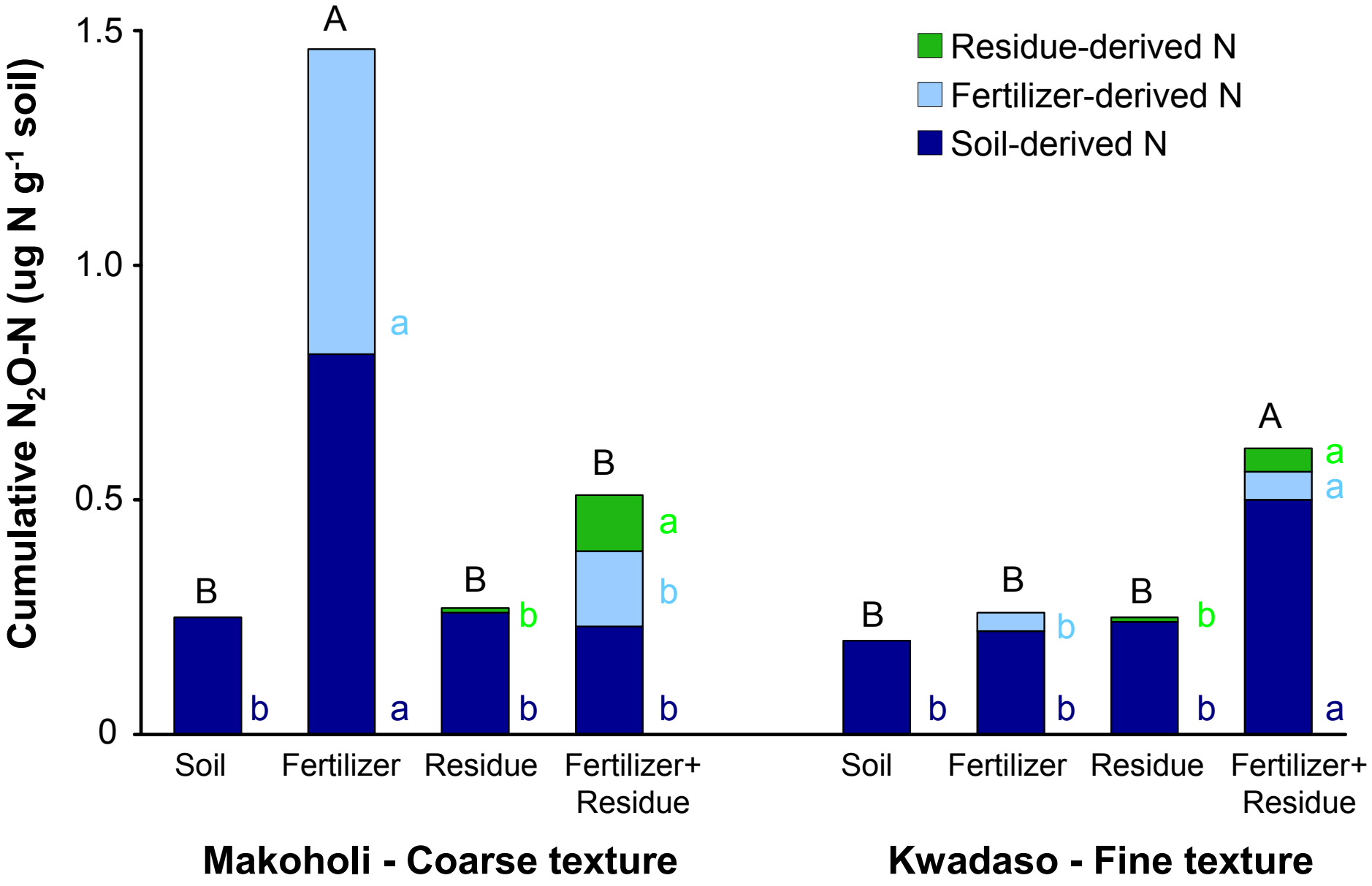
➢ System losses of N

Interactive Effects - N_2O Losses



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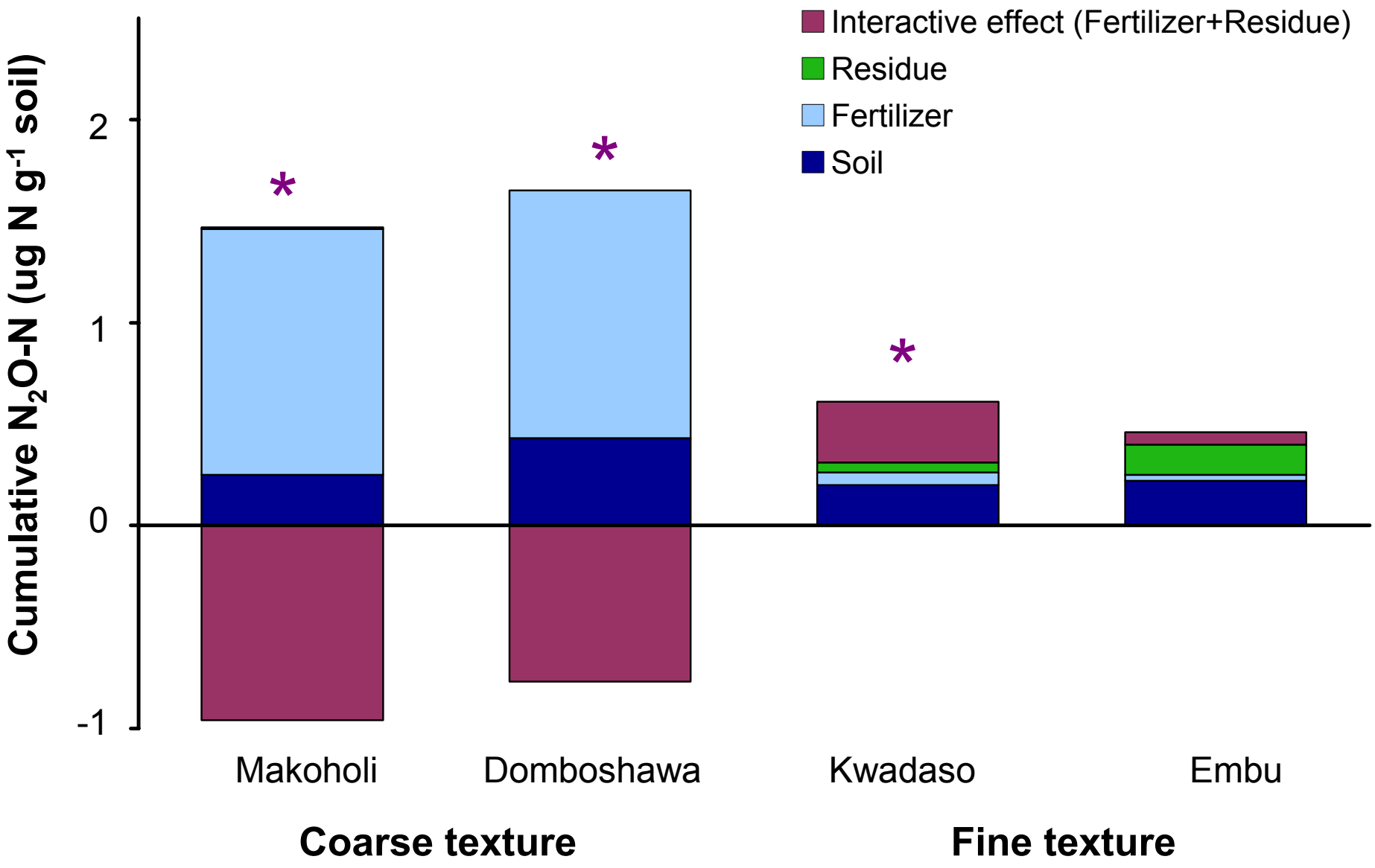
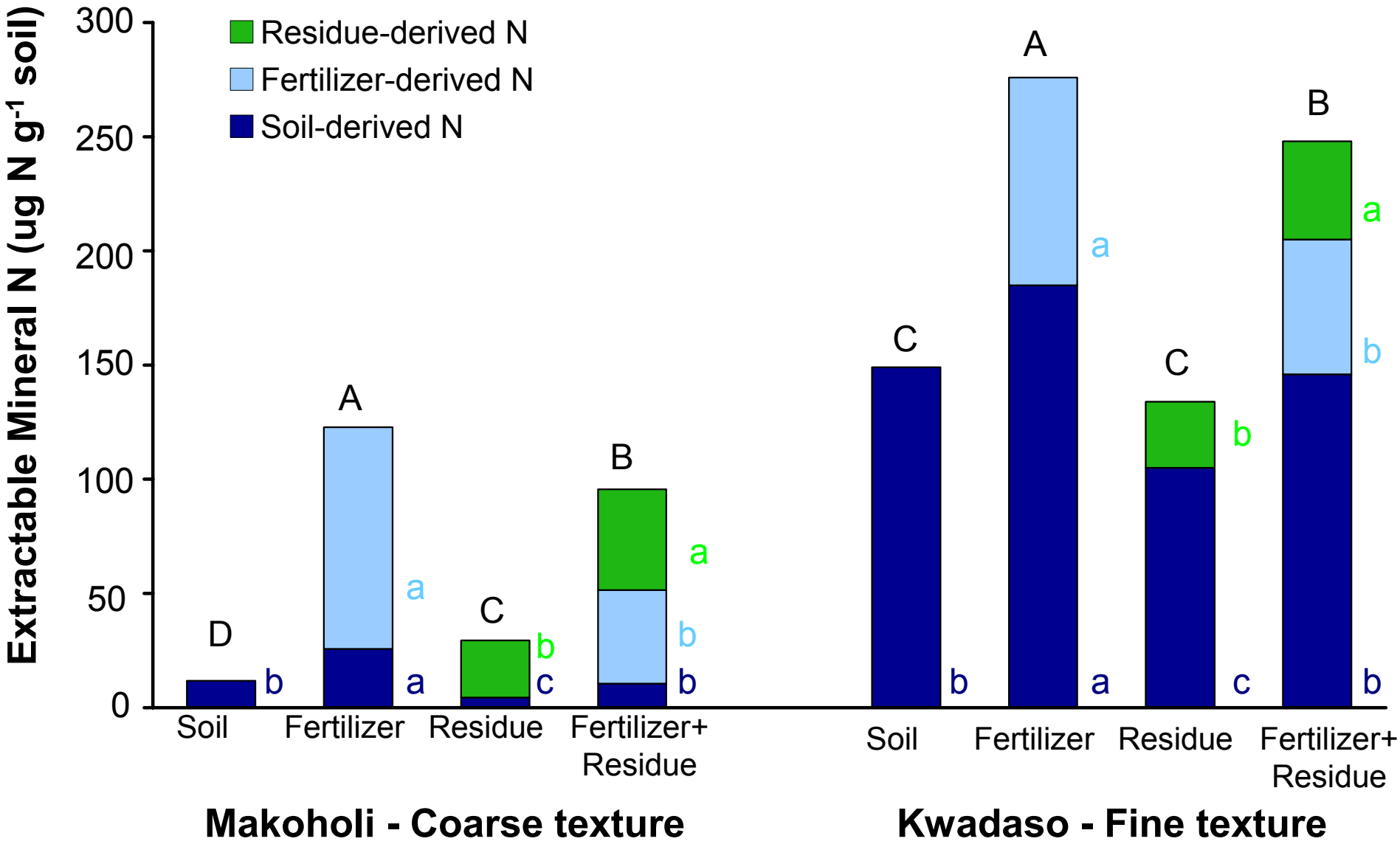


Interactive Effects - Mineral N Dynamics



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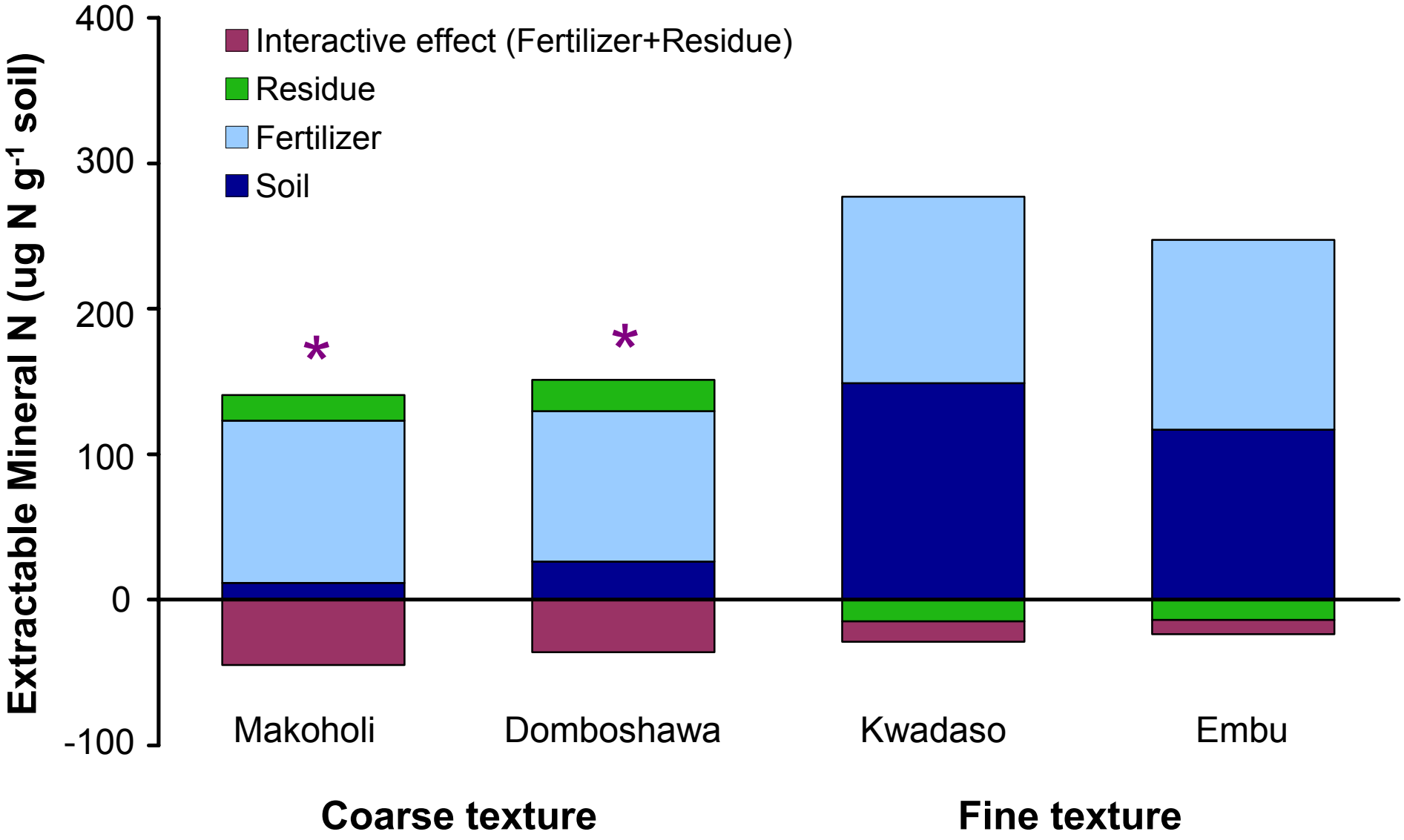

Implications of Results

- Combining fertilizer and residue resources
  - Decreases N_2O losses (coarse soils)
  - Increases N_2O losses (fine soils)
  - Immobilizes mineral N

➢ Reduces overall N losses through interactive effect