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# Linking Stable Isotope Methods and Electrical Resistivity Tomography Imaging: Improving Our Understanding of Competition in Poly-Culture Systems

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## Abstract

Poly-cultures are cropping systems using multiple crops in the same space and time, avoiding large stands of sole crops, hence contributing to reconciliation ecology. These land uses have several advantages over monocultures, *e.g.* increased biodiversity and diversification of agricultural production. Coupled with soil conservation measures, they also contribute to erosion control and resource protection in fragile areas. The viability of such systems often depends on their efficiency under limited resource conditions, which in turn makes them acceptable among the farming community. Most farmers, however, are reluctant to adopt such systems because they may compete for water and nutrients. This study was conducted during 2011 on the Queen Sirikit research farm, Ban Bo Wi village, Ratchaburi province, in North-West Thailand to investigate the competition in maize based soil conservation systems. The soil at the field site ranged from an endoleptic Alisol to ahyper skelletic Leptosol. The treatments were maize under farmer's practice (control) and maize-chili intercropping combined with alley cropping of Leucaena under minimum tillage and Jack bean relay cropping with and without fertiliser application. Plot size was 4 m by 13 m and slope of 18–20 %. We used both carbon isotopic discrimination and electrical resistivity tomography (ERT) imaging, a novel non-invasive method, to understand and distinguish the competition for water and nutrients in tropical field conditions. A negative relationship was observed between $^{13}C$ isotopic discrimination and total nitrogen in grain with $R^2$ ranging from 0.63 ($p \leq 0.01$) to 0.70 ($p \leq 0.001$) while a positive correlation was found between total nitrogen in grains and total dry matter production with $R^2$ ranging from 0.51 ($p \leq 0.04$) to 0.84 ($p \leq 0.001$). Nutrient competition induced an increase in $\delta^{13}C$ values in maize rows close to Leucaena hedgerows and decreased their total dry matter production. ERT imaging showed different water depletion patterns during the growing season, directly linked with the growth and development of maize such as leaf area index, plant height and canopy cover. This helped explaining the impact of hedgerows on crop growth and yields in maize rows adjacent to the hedges, leading to various spatial patterns along the slope.

**Keywords:** Competition, destructive methods, maize, non-invasive methods

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