Potassium application to alleviate drought stress in cassava production

A growth chamber based carbon-13 pulse labelling experiment

Context

• Cassava roots are an important staple crop
• Climate change will increase dry spell frequency
• Drought will affect cassava production

• Can potassium help alleviating drought stress?
• How can we measure water stress with stable isotopes?

→ $^{13}$C-CO$_2$ pulse labelling experiment
Experiment

• Control plants harvested before labelling
  • Check for natural abundance levels of $\delta^{13}$C
  • Is $\delta^{13}$C related to water stress in cassava?

• $^{13}$C Labelled plants harvested at different periods
  • Can we see a difference in distribution of assimilates under stress?
  • Does potassium increase carbon allocation to roots?
Methods

• 2 fertilizer solutions (from beginning):
  • K+  (1.437 mM K⁺)
  • K⁻  (0.359 mM K⁺)

• 2 water treatments (during 3 week stress period):
  • 100 % of pot capacity
  • 50 % of pot capacity

• $^{13}$C-CO₂ pulse label applied after 1 week of drought stress

• 3 harvest (H) times (8 hours, 9 days and 24 days after labelling)
First results

• Water use of K+ plants in initial phase 5% lower than for K- plants
  → **K+ to avoid water use when root system is not yet fully developed?**
• Natural abundance $\delta^{13}C$ of upper parts (bulk) in optimally watered plants 1.5‰ lower than for water stressed plants
  → **$\delta^{13}C$ as proxy for water stress in cassava**
• Newly assimilated $^{13}C$ found in roots already at first harvest
  → **Shorter sampling times needed to see translocation**
• Lower stem part contained up to 30% of new assimilates – roots only 14%
  → **Lower stem as intermediate storage organ?**
What could be improved

• A more drastic potassium treatment is advised
  • No differences in leaf potassium content could be found

• More harvesting times closer to labelling to measure translocation speed to the roots

• Sampling for different (non)-structural carbon pools to follow mobile and less mobile assimilates

• High variability in cassava growth should be counteracted with more replicates and more homogeneous planting material