Below and aboveground pigeonpea productivity in on-farm sole and intercrop systems in central Malawi

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Participatory on-farm study

Africa RISING: Africa Research in Sustainable Intensification for the Next Generation

Aim: “Transforming agricultural systems through sustainable intensification projects..”

Map courtesy of: Brad Peter Department of Geography. Michigan State University (2015)
Experimental design

- Central Malawi
- Trials set up in 2012
- Experimental study monitored in 2014
- Mother & baby trials
- Four mother trials
- 40 baby trials
- RCBD, 3 reps

Adopted from Rusike, Snapp and Twomlow (2005)
Including multi-purpose legumes in maize-based systems

- Perennial
- Produces grain
- Improves soil fertility
- Ideal for intercropping
- Biological nitrogen fixation
- Low - medium labor requirements
- Potential for producing tons of N-rich biomass

Is pigeonpea one such legume?
Measuring the ‘hidden half’

- Complex
- Laborious
- Expensive
- Time consuming
- Destructive sampling
To assess the effect of cropping system and soil texture on pigeonpea root and shoot biomass

To evaluate variability of pigeonpea growth within a smallholder farm context
Hypotheses

Cropping system will have a significant effect on both root and shoot biomass of pigeonpea and that it will be highest in the sole pigeonpea cropping system and lowest in the pigeonpea/maize intercrop.

Heavy textured soils will have higher root and shoot biomass than light textured soils.

The pigeonpea/maize intercrop will have the highest variability compared to other cropping systems.
Aboveground biomass assessment

- Litter traps - 10 weeks
- Destructive sampling
- 6 months after planting
- 3 plants per plot, 3 x reps
Aboveground biomass assessment cont...
Belowground biomass assessment
Belowground biomass assessment cont...

0 - 20 cm

20 - 40 cm

40 - 60 cm
Soil analyses

- Soil pH
- Soil texture
- Total soil N %
- Soil organic C %
- Inorganic N (NH$_4$ + NO$_3$)
- Potentially mineralizable N
Results: Aboveground biomass

The diagram above illustrates the aboveground biomass (Mg/ha) for different cropping systems. The abbreviations c, b, ab, and a indicate different levels of biomass. The colors represent different components of the biomass:
- Stems
- Twigs
- Leaves
- Pods
- Initial leaf fall
- Litter
Results: Belowground biomass

![Graph showing total root biomass (Mg/ha) for different cropping systems.](image)

- Sole Pigeonpea
- Pigeonpea/Gnut
- Pigeonpea/Soya
- Pigeonpea/Maize

*(α = 0.05)*
Results: Soil texture & roots

![Graph showing total root biomass (Mg/ha) for light and heavy soil textures.]

- Light soil texture: Total root biomass (Mg/ha) is indicated by the green bar labeled 'a'.
- Heavy soil texture: Total root biomass (Mg/ha) is indicated by the yellow bar labeled 'b'.

The graph illustrates a significant difference in total root biomass between light and heavy soil textures, with heavy soil having a higher biomass. The significance level is indicated as $\alpha = 0.05$. 

(Michigan State University)
Results: Soil ammonium

![Bar chart showing soil ammonium levels across different cropping systems and soil depths.](chart_image)
Conclusions

- Overall root growth followed shoot growth
- Heavy textured soils associated with higher root biomass
- Intercrop systems suppressed pigeonpea roots and shoots
Conclusions & Future directions

- Pigeonpea least suppressed when intercropped with groundnut

- Pigeonpea/groundnut system may be a best bet compromise- grain & soil fertility enhancement

- Pigeonpea/Gnut released by the Malawi technical release committee

- Total shoot and root biomass of all pigeonpea & companion crops?
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Questions and Answers