Missing the obvious
Biomass, density and carbon of shrubs

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Alley cropping
agroforestry system

Field campaign
in February 2025

Destructive sampling
of shrub hedges

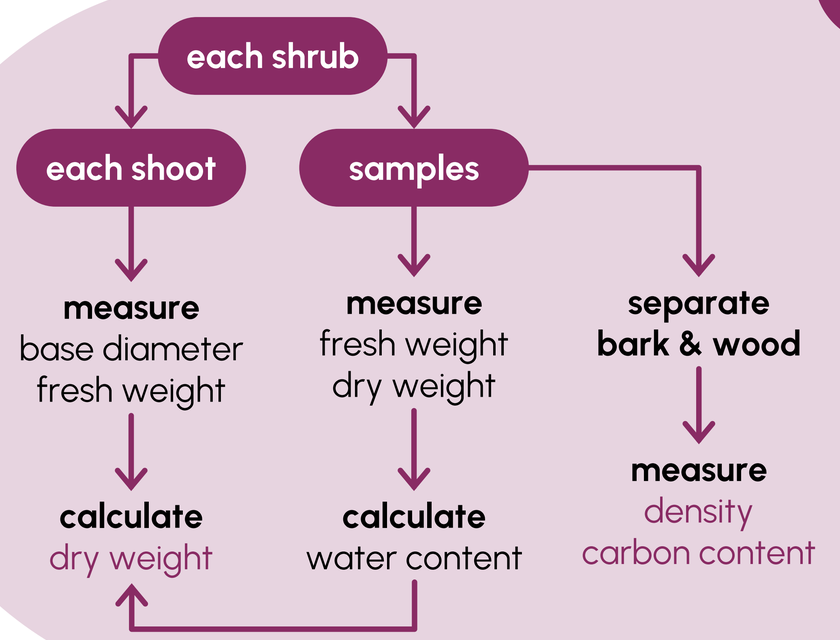
universität freiburg

Introduction

- in Europe, hedges on agricultural land are one of the **most common** types of **agroforestry systems** (AFS) [1,2]
- hedges provide various economic, ecological & cultural **benefits** [3-5]
- while **detailed information** on tree growth has been documented in yield tables already more than 200 years ago [6], such information is **scarce** for shrubs [7]
- **research goal:** detailed information on dry above-ground **biomass** (AGB), dry wood & bark **density** (ρ) and **carbon** content ($C_{\%}$) of 12 shrub species growing in hedges within an 18 year old AFS

12 species
97 shrubs
572 shoots

Methods



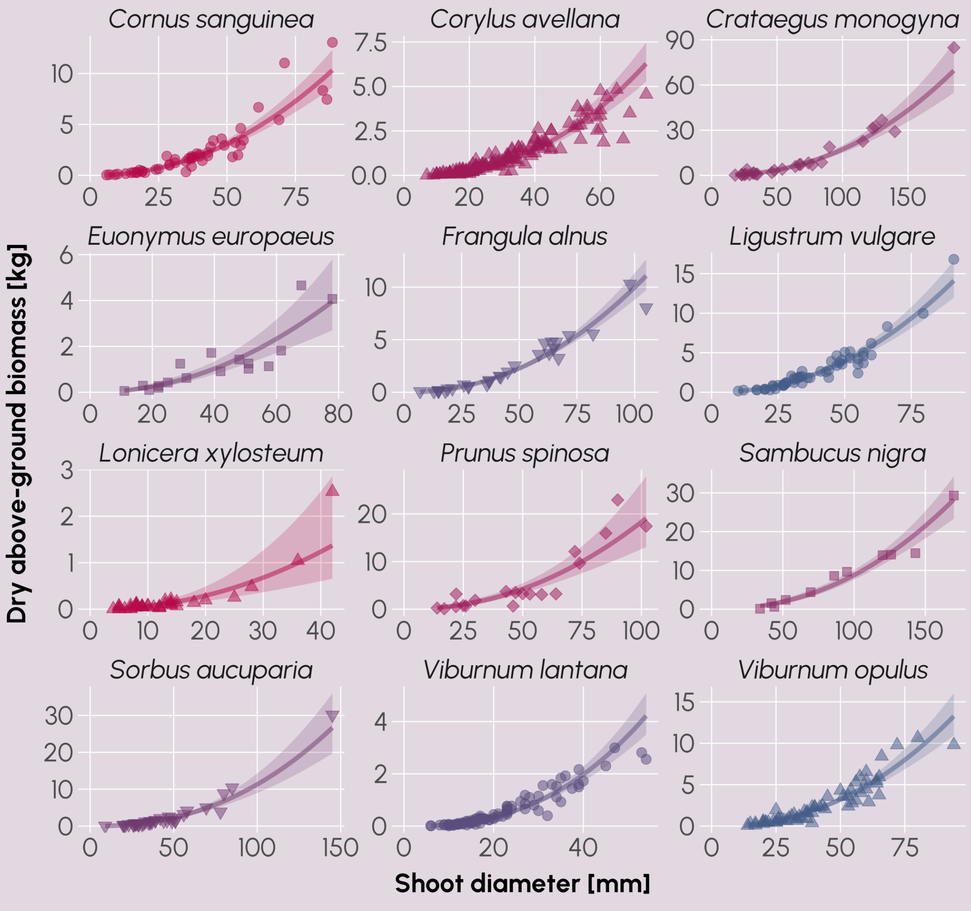
regression models

shoot biomass
ln(AGB) ~ ln(diameter)

density
ρ ~ species × compartment + species × diameter

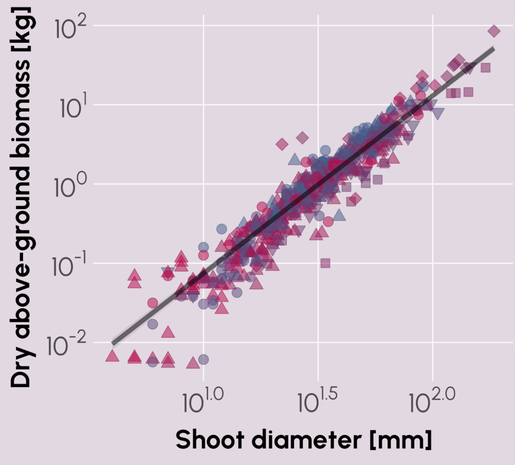
carbon content
$C_{\%}$ ~ species × compartment

Results



shoot biomass (per species)
model fit
R^2_m → 0.74 - 0.98
R^2_c → 0.84 - 0.99

shoot biomass (generalised)
model fit
$R^2_m = 0.93 \mid R^2_c = 0.97$



density
range
ρ_{bark} → 0.23 - 0.76 g cm^{-3}
ρ_{wood} → 0.50 - 0.92 g cm^{-3}

model fit
$R^2_m = 0.79 \mid R^2_c = 0.82$

significant effects:
- diameter
- species × diameter

carbon content
range
$C_{\%\ bark}$ → 43.0 - 51.2%
$C_{\%\ wood}$ → 45.3 - 46.9%

model fit
$R^2 = 0.94$

significant effects:
- species
- compartment
- species × compartment

generalised model
ln(AGB [kg]) = -2.60 + 2.24 × ln(D [cm])

Innovations

for some of the species
- first time biomass allometries
- first time dry bark & wood density
- first time wood & bark carbon content

Conclusion

inter- & intraspecific heterogeneity of biomass allometries, dry density & carbon content → **generic parameters are inadequate for carbon stock estimation**

strengthening empirical basis for shrubs is important for evidence-based sustainable land management → **more research on further species & sites is required**

potential applications
- assess hedge carbon stocks
- estimate carbon storage potential
- simulate shrub growth
- blueprint for further research

References

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Thanks for reading! This research is currently under peer-review in *Scientific Reports*.
Once published, you may find it at www.humax-projekt.de or at www.agroforst-info.de/modema.

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