Combustion properties and quality of the perennial wild plants common tansy (*Tanacetum vulgare* L.), common knapweed (*Centaurea nigra* L.) and mugwort (*Artemisia vulgaris* L.)

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Background:

- Perennial wild plants (PWPs) common tansy, common knapweed and mugwort not only provide biomass for biogas production, but also food supply for pollinators and versatile habitats for open land animals.
- These ecosystem services could be improved shifting the harvest date from late summer to late winter and using the PWPs for thermochemical conversion instead of anaerobic digestion.

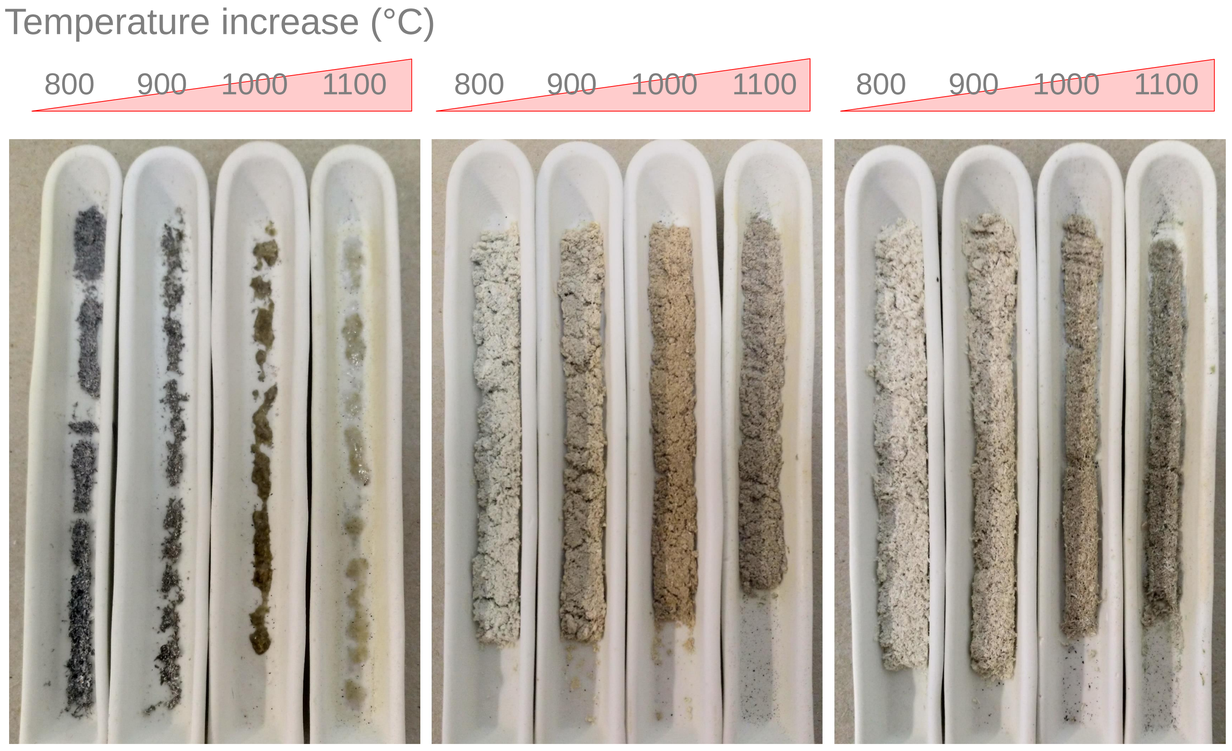
Research question:

What are the combustion properties of common tansy, common knapweed and mugwort in comparison with common perennial industrial crops?

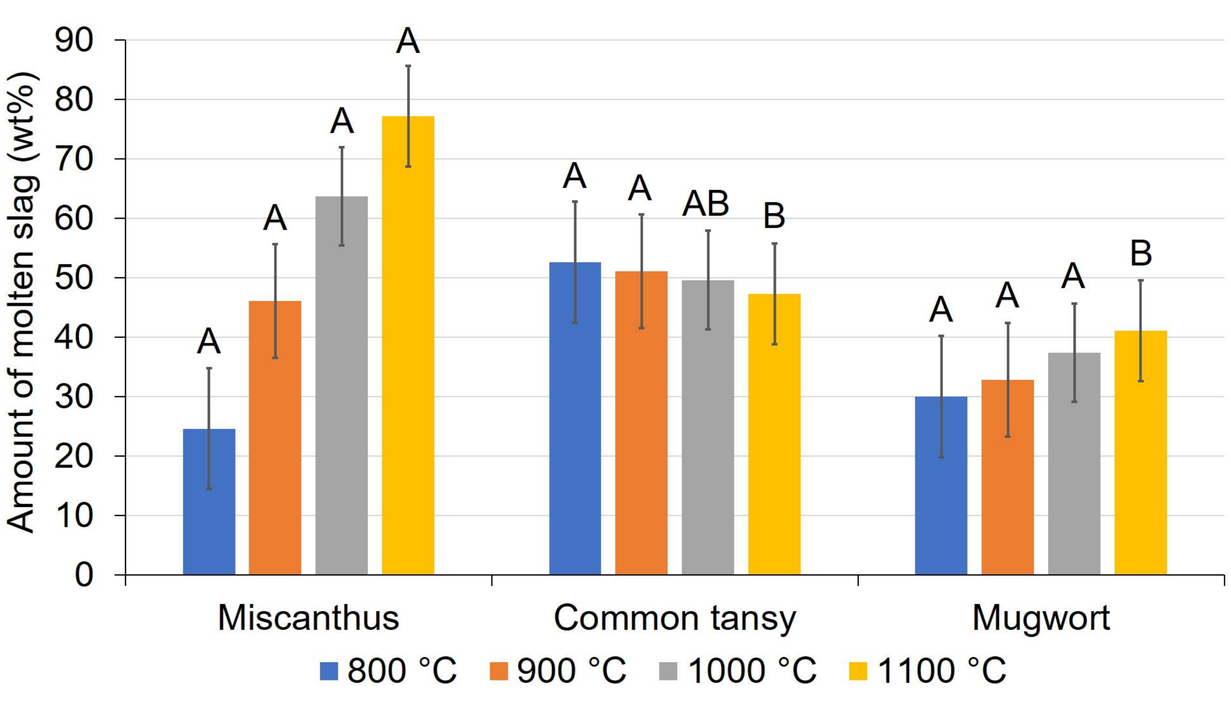
Common tansy (*Tanacetum vulgare* L.)

Common knapweed (*Centaurea nigra* L.)

Mugwort (*Artemisia vulgaris* L.)



(A) Optical phase change of ash of common tansy and mugwort in comparison with *Miscanthus* at temperature rease from 800 to 1100 °C.



(B) Computed ash fusibility for each investigated feedstock sample in this study. Every temperature displays the exact amount of molten slag. Different letters: significant ($p < 0.05$) differences between crops within temperatures.

Material and Methods

- Long-term field trial in Hohenheim, harvest: February 2020
- Dry matter yield, lignocellulosic and elementary composition
- Higher heating value, energy yield per hectare
- Ash melting behavior *in situ* (A), and using FactSage (B)

Results & Discussion

- Energy yield of PWPs twice as high through combustion compared with anaerobic digestion
- Tansy and mugwort showed better ash melting behavior and similar higher heating value (16-17 MJ kg^{-1}) compared with *Miscanthus* (A, B) and switchgrass
- Combustion properties of all PWPs somewhat comparable to Sida (*Sida hermaphrodita* L. Rusby), but lower dry matter yields lead to lower energy yield per hectare (130.2–221.6 GJ ha^{-1}) → 446.8 GJ ha^{-1} were reported by Jablonowski et al., 2017 (https://doi.org/10.1111/gcbb.12346)

Conclusions

- PWPs have a low methane yield potential, thus farmers hesitate in growing PWPs, although the other ecosystem services are convincing.
- Switching to thermochemical conversion could help increase energy yield per hectare of PWPs, thus convince more farmers of PWP as a complementary bioenergy cropping system and thereby further contribute to a more ecologically sustainable transition to a bioeconomy.