Combustion quality of 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 (Figs. A–C) provide the greatest long-term methane yield within novel perennial wild plant mixtures. The PWPs also provide a rich nutritional resource and habitat for animals, especially pollinators.
- Harvesting in winter would enhance these ecosystem services. PWP biomass would then be more suitable for thermochemical conversion, like Sida (Fig. D), but this has not yet been reported.

Research aim

Gain first insights into the combustion quality of perennial wild plant species.

Common tansy (*Tanacetum vulgare* L.)

Common knapweed (*Centaurea nigra* L.)

Mugwort (*Artemisia vulgaris* L.)

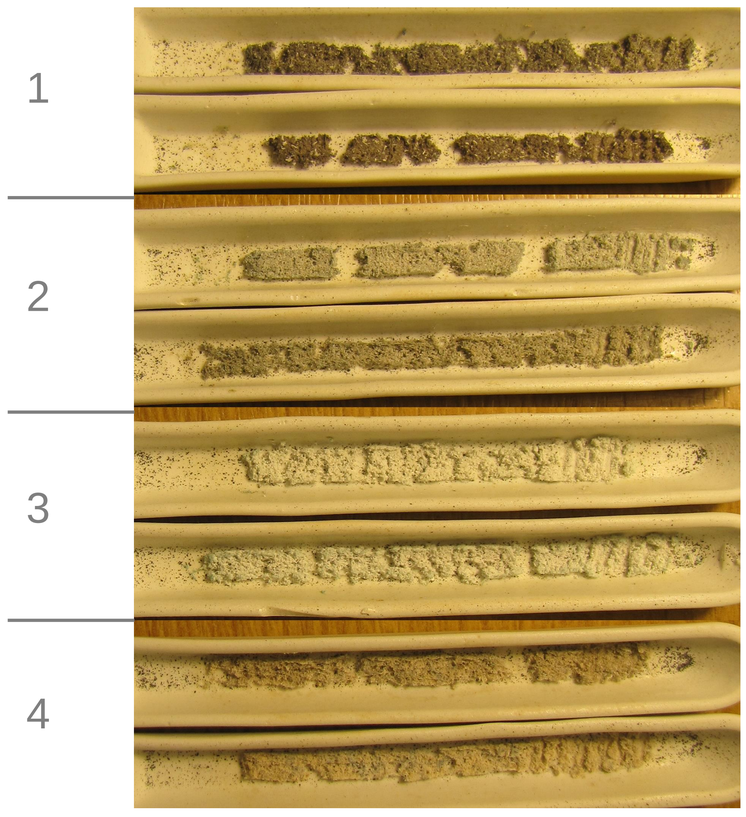
Sida (*Sida hermaphrodita* L. Rusby)

Material and Methods

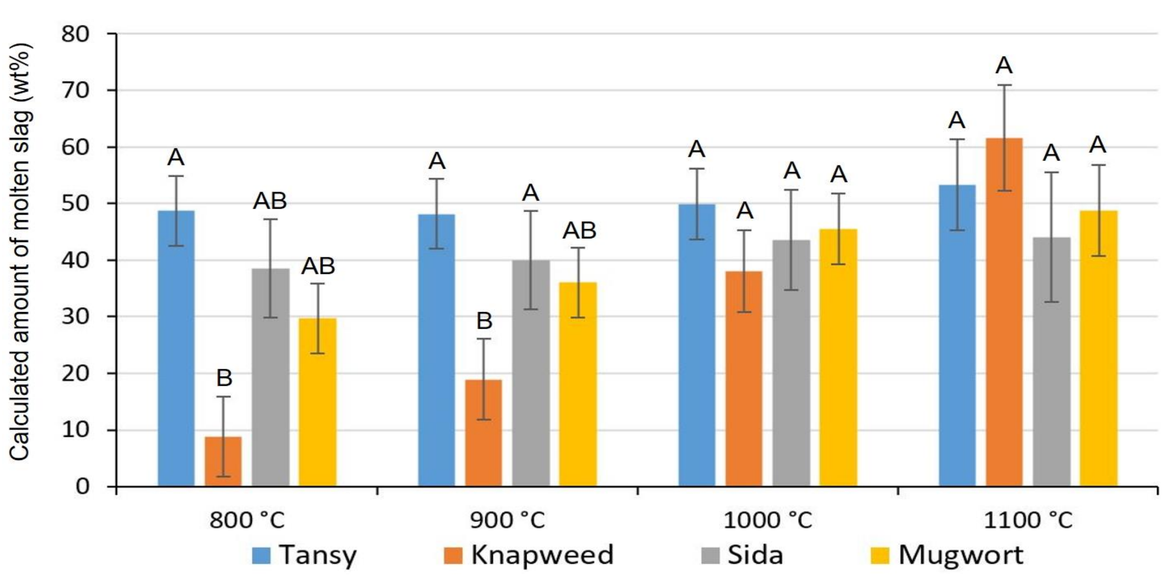
- PWP and Sida harvested February 2020 from a long-term (since 2014) field trial.
- Determination of biomass yield, higher heating value, substrate-specific methane yield and ash melting behavior [*in situ* (Fig. E), and using FactSage (Fig. F)].

Results & Discussion

- PWPs showed 2 to 3 times higher energy yield through combustion versus anaerobic digestion.
- PWPs showed a higher heating value of 16–17 MJ kg^{-1}.
- Despite comparable ash melting behavior (Figs. E,F) PWPs would result in lower energy yield per hectare (130–222 GJ ha^{-1}) compared to Sida (447 GJ ha^{-1}, Jablonowski et al., 2017 (https://doi.org/10.1111/gcbb.12346) due to low dry matter yields of 7.3 (mugwort)–13.7 Mg ha^{-1} yr^{-1} (common tansy).



(E) Visual differences in ash melting behavior of wild plant species and Sida at 1100 °C. (1 = Common tansy; 2 = Common knapweed; 3 = Sida; 4 = Mugwort).



(F) Computed ash fusibility for the wild plant species and Sida. Every temperature displays the exact amount of molten slag. Different letters: significant ($p < 0.05$) differences between crops within temperatures.

Conclusions

- PWPs have a promising total ecosystem service potential, yet farmers are hesitant to grow PWP due to low energy yields when using the biomass for biogas production.
- Switching to thermochemical conversion could help increase energy yield per hectare, leading to greater adoption of PWPs as a complementary bioenergy cropping system. In terms of an agro-ecological approach, this could contribute significantly to a more environmentally friendly and sustainable transition to a bioeconomy.

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