Towards a closer understanding of *Sida hermaphrodita*: plant establishment, performance, and biomass utilization

Dr. Nicolai D. Jablonowski, Institute of Bio- and Geosciences, IBG-2: Plant Sciences, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany, Phone +49-2461-61-8682 Fax -2492, e-mail: n.d.jablonowski@fz-juelich.de

Abstract

Due to an increased awareness of both climate change and limited fossil resources, the demand of alternative energy carriers such as biomass has risen significantly during the past years. This development is supported by the idea of a transition to a bio-based economy reducing fossil-based carbon dioxide emissions. Ambitious goals were set for the European Union (EU) in the Renewable Energy Directive taking into account specific objectives, aiming for "developing the decarbonisation potential of advanced biofuels" and "develop renewable energy potential in the heating and cooling sector"– to which biogenic solid fuels provide a substantial contribution. Based on the current trend, biomass for energy is expected to be used mainly for heating until the end of the decade.

The perennial herbaceous mallow plant *Sida hermaphrodita* (L.) Rusby, also known as Virginia fanpetals (hereafter referred to as Sida) attract growing interest for its potential as an alternative biomass plant for energy purposes.

We present a cropping strategy for the cultivation of perennial plants on marginal soils using *Sida hermaphrodita* as a promising example. By combining the perennial species with organic fertilization in an extensive cropping system, the soil fertility increases over time, guaranteeing substantial biomass yields on marginal soils. Following the idea of a closed nutrient loop, we use digestate, an organic residue, as fertilizer and soil amendment. Legumes are intercropped to fix additional nitrogen into the plant-soil system and produce additional biomass, enriching the production system over time. The perennial nature of the energy crops strongly reduces the need for soil cultivation as well as pest and weed control. Subsequently, data on Sida biomass used as a solid fuel for combustion and biogas feedstock will be presented.

We conclude that the combination of different extensive cropping strategies will enable farmers to increase the fertility of marginal soils, resulting in substantial biomass yields. Further, the extensive nature of the cropping system accommodates the ecological value of marginal soils. Overall, Sida biomass used as a solid fuel for combustion purposes appears to be the most promising option.

Related references:

1. Nabel M, Schrey SD, Poorter H, Koller R, Nagel KA, Temperton VM, Dietrich CC, Briese C and Jablonowski ND (2018) Coming Late for Dinner: Localized Digestate Depot Fertilization for Extensive Cultivation of Marginal Soil With Sida hermaphrodita. Front. Plant Sci. 9: 1095.

2. Nabel M, Schrey SD, Temperton VM, Harrison L and Jablonowski ND (2018) Legume Intercropping With the Bioenergy Crop Sida hermaphrodita on Marginal Soil. Front. Plant Sci. 9: 905.

3. Nabel M, Schrey SD, Poorter H, et al. (2017) Effects of digestate fertilization on Sida hermaphrodita : Boosting biomass yields on marginal soils by increasing soil fertility. Biomass and Bioenergy 107: 207–213.

4. Damm T, Grande PM, Jablonowski ND, Thiele B, Disko U, Mann U, Schurr U, Leitner W, Usadel B, Domínguez de María P, Klose H (2017). OrganoCat pretreatment of perennial plants: Synergies between a biogenic fractionation and valuable feedstocks. Bioresource Technology, 244/1: 889-896.

5. Damm T, Pattathil S, Günl M, Jablonowski ND, O'Neill M, Grün KS, Grande PM, Leitner W, Schurr U, Usadel B, Klose H (2017). Insights into cell wall structure of Sida hermaphrodita and its influence on recalcitrance. Carbohydr Polym, 15/168: 94-102.

6. Nabel, M., Temperton, V. M., Poorter, H., Lücke, A. & Jablonowski, N. D. (2016). Energizing marginal soils – The establishment of the energy crop Sida hermaphrodita as dependent on digestate fertilization, NPK, and legume intercropping. Biomass and Bioenergy, 87: 9-16.

7. Jablonowski, N. D., Kollmann, T., Nabel, M., Damm, T., et al. (2017). Valorization of Sida (Sida hermaphrodita) biomass for multiple energy purposes. GCB Bioenergy, 9: 202-214.

8. Nabel, M., Barbosa, D. B., Horsch, D. & Jablonowski, N. D. (2014). Energy crop (Sida hermaphrodita) fertilization using digestate under marginal soil conditions: A dose-response experiment. Energy Procedia, 59: 127-133.

9. Barbosa, D. B. P., Nabel, M. & Jablonowski, N. D. (2014). Biogas-digestate as nutrient source for biomass production of Sida hermaphrodita, Zea mays L. and Medicago sativa L. Energy Procedia, 59: 120-126.