Società Italiana di Agronomia
50° Convegno Nazionale

Evoluzione dei sistemi agronomici in risposta alle sfide globali
Udine, 15-17 settembre 2021

Integrated Food-Energy Cropping Systems

Andrea Parenti[1], Walter Zegada-Lizarazu[1], Andrea Monti[1]

[1] DISTAL - Dipartimento di Scienze e Tecnologie Agro-Alimentari

Autore corrispondente: andrea.parenti5@unibo.it

Introduction

Biomass sorghum, sunn hemp, kenaf and hemp are annual low input high cellulose yielding crop which could be used as dedicated energy crop without competing with winter cereals and potentially planted as double crop to avoid iLUC. Under optimal pedo-climatic conditions biomass sorghum, kenaf and industrial hemp are able to reach up to 30, 20 and 23 Mg ha^{-1}, respectively. Besides, sunn hemp is also able to yield from 7 Mg ha^{-1} when double cropped in late planting, to 20 Mg ha^{-1} as main crop in irrigated Mediterranean environments. Besides, the composition of the biomass is important to identify the potential best suited feedstock to biofuel production. High cellulose and hemicellulose paired with low lignin, ash and inorganic elements are essential in the thermochemical conversion to maximize the process efficiency and reduce slugging, fouling, and corrosion tendencies.

Materials and Methods

Crop rotations were established in 2017 at the experimental farm of the University of Bologna in Cadriano (32 a.s.l., 44° 33' N, 11° 21' E) in a loam silty soil.

Five innovative rotations and a control were established in a randomized block design with four replications. Each plot was settled to allow a complete mechanical management to simulate the upgrading to large scale. The plots were 231 m^2 each, with an overall area per treatment of 924 m^2. The six systems during the three years rotation (2018-2020) were designed as follow:

	2017 (A M J J A S O N D)	2018 (J F M A M J J A S)	2018 (O N D) – 2019 (J F M A M J)	2019 (J A S O N D)	2020 (J F M A M J J A S)
C	Maize		Wheat		Maize
R1	Maize	Sunn Hemp	Wheat	Sunn Hemp	Maize
R2	Maize	Fiber sorghum	Wheat	Sunn Hemp	Maize
R3	Maize	Kenaf	Wheat	Sunn Hemp	Maize
R4	Maize	Hemp	Wheat	Sunn Hemp	Maize

Results

The overall grain yield was similar between the five rotations and did not differ from Control (Table 1). Otherwise, the overall biomass resulted higher for R2 and R5 due to the significant contribution of biomass sorghum and the intensiveness of the rotation, respectively.

	Food	Biomass (%)
R1	ns	+184 b
R2	ns	+240 a
R3	ns	+168 c
R4	ns	+200 b

Table 1. Grain yields and aboveground biomass per rotation compared to Control rotation

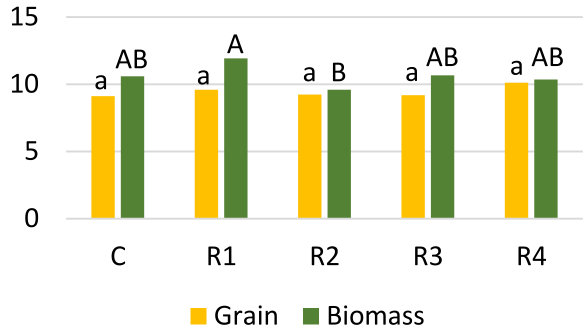

Figure 1. Grain and biomass yield for maize 2020 (at the end of the rotation)

All parameters were subjected to the analysis of variance ($P < 0.05$) and the LSD test was used for means comparison separately for grain and AGB production.

The productivity of maize in 2020 (Figure 1) was affected in the stover component. Significantly higher yield was observed in R1 compared to R2 and R4, possibly due to the rotational effect. Biomass sorghum resulted as the most suitable feedstock for thermochemical conversion, due to a general lower ash (<5%), nitrogen (<1%) and lignin (5%) content paired with high cellulose and hemicellulose concentration (58%).

Conclusions

The proposed system did not negatively impact the food production over the three years. Furthermore they were able to increase the biomass for the bioenergy sector, enhancing crop diversification and biodiversity compared to the control rotation. In particular, R2 (maize-biomass sorghum-wheat+sunn hemp-maize) maximized the food/biomass productivity even though the rotational effect might have affected maize 2020 productivity. Indeed, biomass sorghum stands out in terms of desirable characteristics for bio/thermochemical conversion with high cellulose and hemicellulose content and low ashes. However, sunn hemp confirmed to be an extremely promising legume crop.

BECOOL
Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels

Acknowledgments: this study was funded by the BECOOL project that receives funding from Horizon 2020 (H2020) under the grant agreement No. 744821