Società Italiana di Agronomia
XLVII Convegno Nazionale

L'Agronomia nelle nuove Agri*culturae*

Marsala (TP), 12-14 settembre 2018

A Follow Up Study Of Biomass Yield Of Saccharum spontaneum ssp. aegypticum Under Water Regimes

Research funded by MAGIC project (GA 727698)

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Introduction

Mediterranean climates are characterized by long periods of drought during summer and short dry periods from autumn to spring, what limits plant CO_2 assimilation and biomass production to a great extent. The JRC has set a series of thresholds to define marginal lands in terms of biophysical constraints. We focus on climate limitation given by the ratio between precipitations and potential evapotranspiration (P/ET). Areas with P/ET ≤0.60 are classified as affected by "dryness". The present study follows up a long-term plantation of the C_4 perennial grass *Saccharum spontaneum* ssp. *aegypticum* under different water regimes in a semi-arid Mediterranean environment.

Materials and Methods

Saccharum spontaneum ssp. *aegypticum* was established in 2005 at the Experimental farm of the University of Catania. Materials and methods are extensively reported in Cosentino et al. (2015).

Here we report the biomass yield following the study of Cosentino et al. (2015), namely 10th, 11th and 12th growing season (2014/15, 2015/16, 2016/17, respectively).

Through the growing seasons, meteorological conditions and potential evapotranspiration were continuously measured, then the P/ET ratio was calculated.

The relative yield reduction (%) among irrigation treatments was calculated according to: $[(1 - (X_0\text{-}_{50}/X_{100}) \times 100)]$, where X_0 and X_{50} are biomass yields at rainfed and 50% of the maximum ET restoration, and X_{100} represents biomass yields at 100% of the maximum ET restoration.

A one-way ANOVA using repeated measurements in time was adopted on biomass yield. Duncan's post-hoc test was employed for mean separation at 95% confidence level.

Results

The dryness index greatly changed among growing seasons: it was well above the threshold in 2011 (0.71), slightly higher in 2015 (0.62), slightly lower in 2016 (0.59) and well below in 2012, 2013 and 2014 (0.35, 0.34 and 0.38, respectively) (Table 1).

Table 1. Meteorological conditions and dryness index at the Experimental farm of the University of Catania (37°25'N., 15°03 E., 10 m a.s.l.).

Year	Avg. yearly Tmin (°C)	Avg. yearly Tmax (°C)	Avg. yearly Tmean (°C)	P/ET
2011	12.64	22.63	17.64	0.71
2012	11.17	24.91	18.04	0.35
2013	12.57	23.56	18.06	0.34
2014	13.21	23.69	18.45	0.38
2015	13.59	23.82	18.71	0.62
2016	13.90	23.25	18.57	0.59

Across growing seasons, I_{100} produced 32.8 Mg ha^{-1}, I_{50} 27.6 Mg ha^{-1}, and I_0 22.7 Mg ha^{-1}. The highest yield was achieved at the wettest year (2011), while more variable trends were observed in dry seasons (Figure 1).

Yield reduction in I_0 showed a median of 30.6%, and interquartile between 28.0 and 34.1% (Figure 2). Maximum and minimum values ranged between 37.3 and 26.3%. I_{50} showed a median of 16.5%, interquartile from 13.8 to 17.6%, and maximum and minimum values between 11.8 and 19.5%.

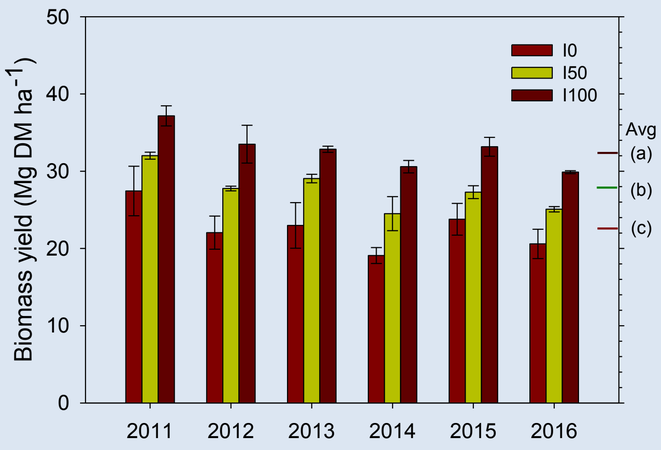

Figure 1. Biomass dry matter yield of Saccharum spontaneum ssp. aegyptiacum under different water regimes and growing seasons.

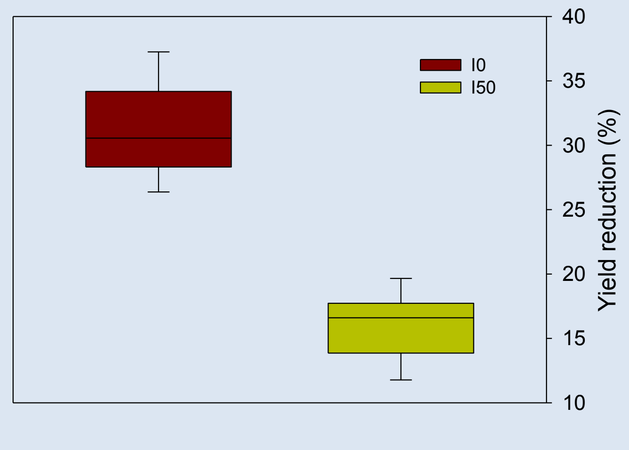

Figure 2. Percentage yield reduction of Saccharum spontaneum ssp. aegyptiacum in rainfed (I_0) and 50% ETm restoration (I_{50}).

Conclusions

The investigation of wild species well adapted to environments dominated by biophysical limitations is a strategy to develop resilient energy crops suitable to hash-prone environments. This study confirmed the desirable traits of the C4 perennial grass *S. spontaneum* ssp. *aegypticum* (Cosentino et al., 2015; Scordia et al., 2015). Biomass production was mostly driven by meteorological conditions through the growing seasons. However, even in the driest seasons, *S. spontaneum* ssp. *aegypticum* was able to maintain satisfactory biomass yield. The relative reduction was in the range of 28.0 to 34.1% in the most stress condition; nevertheless, when the irrigation level was raised to the 50% of the ETm, such reduction strongly reduced to 16.5% as a median value.

Acknowledgments: This was work supported by H2020 MAGIC project (MArginal lands for Growing Industrial Crops: turning a burden into an opportunity, www.magic-h2020.eu)