

PhD School on Agriculture, Environment and Bioenergy
(http://sites.unimi.it/dottorato_aab/)

(XL cycle, 2024-27)

Project draft

1. Field of interest

AGRI-06/B - Chimica agraria

2. Project title

Development of biorefinery from innovative crops (Arundo donax)

3. Tutor (membro del Collegio dei Docenti): Fabrizio Adani

Co-tutor/s: Salvatore Pilu

4. Relevance of the topic and state of the art:

Arundo donax L., common name “giant cane” or “giant reed”, is a plant that grows spontaneously in different kinds of environments and that it is widespread in temperate and hot zones all over the world. A. donax belongs to the Poaceae family, in the tribe of Arundinaceae along with other species.

The adaptability of the plants to different kinds of environments, soils and growing conditions, in combination with the high biomass production and the low input required for its cultivation, confer on A. donax many advantages when compared to other energy crops. The importance of A. donax as a non-food crop is justified not only for the high biomass yields, low agronomic input and low production costs, but, also, for its flexibility of usage. A. donax, in fact, finds application in the production of bioenergy/biofuels not only by biological fermentation, i.e. biogas (Ragaglini et al., 2014) and bio-ethanol (Jaradat, 2010) but also, for direct biomass combustion (Dahl and Obernberger, 2004). Additional industrial uses and the extraction of chemical compounds are largely proved (Tracy and DeLoach, 1998).

Plant versatility and the wide use of its products indicate that A. donax is suitable for the development of a bio-refinery concept. Again, this topic needs to be completely investigated and fully developed.

5. Layout of the project (draft)

5.1. Materials & Methods:

A. donax production will be performed at university experimental station of Landriano where a 12-year plantation exist.

Biomass production and agronomical parameters will be considered. Moreover, in join with Biogas association and private firms, other site (5-10) will be considered to study the effect of pedoclimatic condition on biomass productivity.

Biomass will be characterized by routine analyses but also considering advance chemical and biological techniques to better understand biomass properties vs. final utilization (biofuels, chemical, fermentation).

A biorefinery approach will be considered by applying a cascade approach to valorize biomass by a hierarchy approach.

A final scheme of the biorefinery will be developed to maximize biomass use nulling waste produced

5.2. Schedule and major steps (3 years):

First year: A donax cultivation: agronomical aspects and biomass production vs. pedoclimatic condition

Second year: A. donax biomass uses for biofuels and green chemistry

Third year: developing a biorefinery approach to valorize A. donax biomass. Environmental aspect and sustainability (6 months at foreign research center)

6. Available funds: 100.000 € (Adani/Pilu funding)

6. Literature:

Ragolini G, Dragoni F, Simone M, Bonari E. Suitability of giant reed (*Arundo donax*) for anaerobic digestion: effect of harvest time and frequency on biomethane yield potential. *Bioresour Technol* 2014;152:107–15.

Jaradat AA. Genetic resources of energy crops: biological system to combat climate change. *Aust J Crop Sci* 2010;4:309–23.

Dahl J, Obernberger I. Evaluation of the combustion characteristics of four perennial energy crops (*Arundo donax*, *Cynara cardunculus*, *Miscanthus giganteus* and *Panicum virgatum*). 2nd world conference on biomass energy, industry and climate protection; 2004. p. 1265–70.

Tracy JL, DeLoach CJ. Suitability of classical biological control for giant reed (*Arundo donax*) in the United States. Proceedings of the *Arundo* and saltcedar management workshop, Ontario; 1998.