Improving biomass for bioenergy and bioproducts in Italy: the case of Alasia Franco Vivai

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Introduction
Ensuring increased and sustainable biomass production is critical for European countries. Short rotation coppice (SRC) culture has a great potential to increase biomass supply for bioenergy and bio-based products in Europe. Alasia Franco Vivai (AFV) is one of the biggest EU company in the production of plant material for energetic woody crops. To meet the market needs, AFV developed new genotypes on four of the most used and promising species for biomass production in Europe: Poplar, Willow, Arundo, and Miscanthus.

The business development pipeline for the two strategic crops, Populus and Arundo, is very active with the company looking to expand to additional territories. Furthermore, to strengthen commercial and research activities, AFV has explored potential commercial opportunities (Greenwood resources, USA; International Paper, USA; ENCE, Spain), has established research collaboration with public entities (CNR, University of Tuscia, University of Pisa, University of Pavia), and has been involved in EU projects (POPYOMICS, BENWOOD, NOVELTREE and WATBIO).

In order to make SRC becomes a sustainable opportunity, the selection of new high yielding and site specific genotypes, along with the evaluation of phenotypic plasticity and genotype × site interaction, are of paramount importance. The overall purpose of WATBIO (developing drought-tolerant biomass crops for Europe - http://www.watbio.eu/) is to raise the economic and environmental performance of biomass crops grown on drought-stressed marginal lands by improving the efficiency of plant breeding. In the frame of this project, AFV plays a major role in shaping the project from a commercial exploitation perspective in Europe. Furthermore, AFV has actively contributed to the project activities by supplying putative ecotypes of Arundo donax collected across Europe and by establishing, managing and collecting data in experimental field trials of Populus nigra and A. donax to study their biomass production under drought condition. Altogether, efforts of this research will focus on delivering new germplasm of non-food biomass for second-generation bioenergy, while protecting already stretched water resources.

Perspective
All of the genetic improvement in target traits has been achieved through traditional crossing with a long time from parent selection, crossing to seed production and clonal field testing, during a period of at least 10 years. However, integrating breeding and biotechnologies has the potential to accelerate the rate of tree domestication. Based on recent findings, new avenues for forest breeding whatchainable into account the integration of modern genetic and genomic techniques with conventional breeding will expedite forest tree improvement (Harfouche et al. 2012). In this context, the traditional breeding pipeline could be significantly accelerated using technologies being developed in the WATBIO project.

Ongoing EU Projects
WATBIO
The goal of WATBIO Project is to use the power of next generation sequencing to develop an accurate route for improving new germplasm with enhanced drought tolerance whilst maintaining biomass productivity and quality in water scarce, marginal environments unsuitable for food crops. In the frame of the WATBIO project, AFV will play a major role in shaping the project from a commercial exploitation perspective and will lead in the delivery of impact from relevant exploitable outputs (Photo 3). Until now, the group has actively contributed by establishing and managing field trials. Furthermore, AFV characterized a collection of ~80 ecotypes of A. donax by measuring physiological and morphological traits, and biomass production together with University of Tuscia (Fabbriini et al., under submission), and providing base material that have been studied by WATBIO research teams.

References
Harfouche et al. 2012. Accelerating the domestication of forest trees in a changing world. Trends in Plant Science 17, 64–71
Fabbriini et al. 2015. Comparative study of biomass determinants in a broad panel of giant reed (Arundo donax L.) accessions. Under submission

AFV main activities
Thanks to an ambitious breeding program started in 1983, AFV is the only private Company in Europe conducting this activity, and is now able to offer a wide range of clones adapted to different cultivation systems and site conditions. The genetic improvement pipeline aims at the identification of new lines of selection for biomass which are brought forward parallelly in accordance with the selection criteria differentiated on the basis of the cultivation system (Photo 1) and the final destination of the product. In our genetic improvement program it is possible to identify 6 distinct stages:

1) Germplasm collection from natural populations (Fig.1);
2) Comparison and selection of the best genotypes of each origin;
3) Controlled hybridization;
4) Selection of the best hybrids (Photo 2);
5) Multi site field tests;
6) Clone registration and protection of breeder rights.

Furthermore, AFV clones are present in 19 European countries, North America, Chile and China (Fig. 3).

Fig.1: Places where poplar natural stands have been collected.

AFV is deploying new genetic material of poplar for wide-scale planting for bioenergy and bioproducts, with evident genetic progress being made every year. As the main product of his research activity, AFV has already registered 19 clones (below) in different European countries, with different productive attitudes (Tab.1).

Tab.1: Productive attitudes of 11 of the 19 registered clones.

Fig.3: Countries where AFV materials have been planted.