

Cultivation and characterization of *Cynara cardunculus* for solid biofuels production in the Mediterranean region

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Abstract:

Technical specifications of solid biofuels are continuously improved towards the development and promotion of their market. Efforts in the Greek market are limited, mainly due to the climate particularity of the region, which hinders the growth of suitable biofuels. Taking also into account the increased oil prices and the high inputs required to grow most annual crops in Greece, cardoon (*cynara cardunculus*) is now considered among the most important and promising sources for solid biofuel production in Greece in the immediate future. The reason is that cardoon also known as thistle artichoke, is a perennial crop of Mediterranean origin, well adapted to the xerothermic conditions of southern Europe, which can be utilized particularly for solid biofuel production. This is due to its high calorific value and minimum production cost, as this perennial “invader” may perform high biomass productivity on most soils with modest or without any inputs of irrigation and agrochemicals.

Within the framework of this concept, this research work was focused on the planning and analysis of the different land use scenarios for this specific energy crop and the combustion behaviour characterization for the solid products. The land use scenarios included the validation of cardoon cultivation needs with quantitative estimates of the crop’s production potential in specific soil-climatic environments and the inputs required for its realization in comparison to existing conventional crops. Investigations were based on a number of farm budgets for representative land use systems in Thessaly plain, which is the centre of the Greek agricultural production. As concerns the decomposition behaviour of this biomass material, devolatilisation and char combustion tests were performed in a non-isothermal thermogravimetric analyser (TA Q600). The thermogravimetric tests were performed under inert or oxidative atmosphere, ambient pressure, a heating rate of 20°C/min and particle fraction of 150-250µm. Apart from the thermogravimetric curves, a kinetic analysis was

applied and accrued results were compared with data already available for other lignocellulosic materials.

According to the cultivation efforts, cardoon's growth starts after the first rains in autumn and continues during winter and spring until the beginning of summer when soil moisture drops at very low levels and the aerial part of the plant dries out. The crop is harvested almost dry, i.e. ready for processing, in the period July-September. Many trials with cardoon were carried out in Greece in the last decade showing that this crop may produce 1.2 to 1.7 t d.m. ha⁻¹ under rain fed conditions depending on the winter and spring rainfall, whereas biomass yields in excess of 2,5 t ha⁻¹ are feasible under supplemental irrigation, i.e. 2-3 applications in April-May, when water availability is at greater levels. The thermogravimetric analysis showed that the decomposition process of cardoon follows the degradation of other lignocellulosic fuels, meeting high burnout rates. In spite of the findings achieved up to date, this research work concludes that cynara cardunculus, under certain circumstances, can be used as a solid biofuel of acceptable quality.

Keywords: Energy crops, thermogravimetry, devolatilization, char combustion.