

GIS-based Evaluation of Cardoon (*Cynara cardunculus* L. var. *atilis* DC.) Suitability in Apulia Region



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Cardoon (*Cynara cardunculus* L. var. *atilis* DC.) is a perennial crop producing lignocellulosic biomass and oil from achenes with potential energy use.

The introduction of this species in the cropping systems of a specific area needs a land evaluation of its ecological suitability that is determined by the study of agro-ecological variables such as climate, soil and geomorphology.

In this work, a territorial analysis has been conducted using Geographic Information Systems (GIS) to identify the most suitable areas for cardoon crop production in Apulia region (Southern Italy).

Besides, an ongoing field experiment was planned in 2009 in order to investigate the potential yield of the crop in this area

GIS-based methodology

- Regional data are collected and stored in the software ArcGIS Desktop 9.2 (ESRI).
- Climatic information** was obtained from 188 meteorological stations located within the study area regarding daily minimum, medium and maximum temperature and precipitation. Meteorological database allowed to define two climatic indicators: Crop-specific thermal index (CTI) and Seasonal Rainfall Deficit (SRD) (Giardini et al., 1997).
- Data of **soil physical and chemical characteristics** (texture, gravel percentage, pH, EC, soil depth, organic matter, total carbonate content, period of waterlogging) were taken from Caliendo et al., 2005.
- Slope and land use** (deriving from CORINE Project) were obtained from the Territorial Information Systems of Apulia region (www.cartografico.puglia.it).
- Biophysical parameters were used to draw a map of agronomic suitability of cardoon according to the agronomical classification system of the land "Classificazione Agronomica del Territorio II" (Giardini et al., 1997).
- The methodology allowed to individuate ten agronomical classes, in relation to the ecological limitations of each area for cardoon production; agronomical classes were grouped in four classes according to the suitability of the crop: i) highly suitable (S1); ii) moderately suitable (S2); iii) marginally suitable (S3); iv) not suitable (N).



Main results

- Results of GIS-based agronomic evaluation in Apulia region showed that 5.1% (36,532 ha), 54.2% (384,796 ha), 31.6% (224,251 ha) and 9.1% (64,665 ha) of the arable land area were respectively highly suitable (S₁), moderately suitable (S₂), marginally suitable (S₃) and not suitable (N) for cardoon cultivation.
- Field trial showed a biomass yield of 6.28 t ha⁻¹ of dry weight (41% of heads, 34% of leaves and 25% of stalks) whereas yield in achenes reached 0.75 t ha⁻¹, with an oil content of 23.4%.

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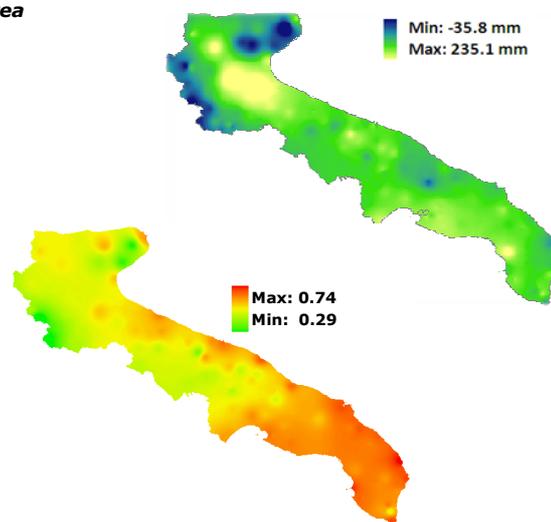


Figure 1: Maps of Climatic Indicators: Seasonal Rainfall Deficit (mm) and Crop-specific thermal index

Field experimental data

- In the year 2009 an experimental trial was carried out at the experimental farm of CRA-SCA located in Rutigliano (Bari, Southern Italy), where climatic conditions are typical of semi-arid Mediterranean area. Seeds were from University of Madrid (Spain) and sowed in autumn with a density of 30,000 plants ha⁻¹. A pre-sowing fertilization with phosphorus application and the chemical control of weeds were used; irrigation was not applied.
- At maturity total crop was harvested, subdividing different parts of the plant; in particular, the achenes were submitted to the determination of oil content by Soxhlet apparatus, using petroleum ether as solvent.

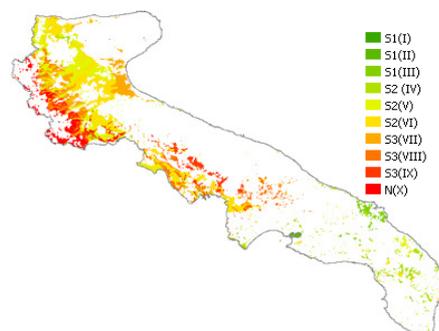


Figure 2: Suitability map of cardoon in arable land of Apulia region (CATII classification system)

Conclusions

According to this results, the introduction of cardoon cultivation in several areas of the Apulia region seems possible even if there are no much experimental data available until now.

This preliminary study confirms biomass yield recorded in other environments of the Mediterranean basin with the same limited water resources and, however, there is still a need to continue the work to better understand and evaluate the real crop potential for energy use.



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