**Castor Oil a new renewable source of biomass for green diesel production.**

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**Highlights**

* The cultivation of castor, in semi-desert or degraded land, is of great interest for the production of more sustainable bio-fuels.
* Eni started an experimental crop of an autochthonous castor genotype in pre-desert lands in North Africa, demonstrating that castor can grow well under harsh climate conditions and with low agronomic inputs.
* The oil extracted from castor seeds of the trial plantation shows a high content of ricinoleic acid and is suitable for processing with Ecofining technology, providing a high quality Green Diesel.

**1. Introduction**

Castor oil is a vegetable oil obtained from the castor plant (Ricinus communis), widely found in tropical and sub-tropical regions of the planet.

Castor oil is composed of triglycerides of different fatty acids and about 10% of glycerine. It has a high oxidation stability and an excellent lubricating capacity. The high content of ricinoleic acid entails a great versatility of use of the oil. Furthermore, the presence of toxic substances such as ricin and ricinine does not make it suitable for food consumption.

The risk of changing the land use, directly or indirectly, from food crops to energy crops is at the base of the problem concerning the sustainability of biofuel production. This aspect is particularly important, as the EU legislation, through the ILUC and RED II directives, intends to limit the use of unsustainable and in competition with food feedstock.

The cultivation of castor is of great interest for the production of bio-fuels as a promising crop for all the tropical and subtropical climate regions. Thanks to its rusticity, in fact, it is a species able to provide high production yields even in conditions of low agronomic and energy inputs in uncultivated and degraded lands. Furthermore, as a no-edible oil, it is not subject to the caps imposed by EU legislation.

In 2018, Eni started an experimental cultivation of an autochthonous castor genotype in pre-desert lands in North Africa. The project aims to prove the feasibility of the crop under harsh climatic conditions and to collect a series of agronomic data, as well as to demonstrate the sustainability of the feedstock. The extraction of castor oil also generates two important by-products, the extraction panel and the residues of the capsules and racemes, which could be used as a soil improver in the plantation itself and for the production of advanced bio-ethanol.

In a second phase a large-scale cultivation will be started which, given the geographical proximity, will allow to feed the bio-refinery of Gela with a more sustainable short supply chain.

The Ecofining technology, jointly developed by Eni and UOP and implemented in the Eni bio-refineries of Venice and Gela, will allow the processing of castor oil obtaining a high quality Green Diesel compared to standard biodiesel. Castor oil has also proved to be an excellent feedstock for the production of jet fuel, given the outstanding cold characteristics of the oil.

**2. Methods**

The trial cultivation started in the pre-desert areas of Tunisia in Tatouine and Gafsa in mid-2018. The soils of the experimental crop are characterized by a very high sand content, a very low value of organic matter and high macro-porosity with low water retention. The cultivated area, divided into different plots, amounts to 140 hectares with a plant density of 2000 plants/ha (spaced 2,5 m between lines and 2 m on the line). The irrigation system adopted is a drip system with highly saline water extracted from in-situ drilled wells. The seeds for sowing were selected from an autochthonous genotype. The agricultural works included plowing of the terrains, fertilization and routine irrigation. Plants germinated after 3-5 days. After a couple of months, the plants were approximately 50 cm tall.

**3. Results and discussion**

After about six months from sowing, it was possible to make a first experimental collection of castor seeds from which the oil was extracted. The characterization of the oil has shown that the content of ricinoleic acid reaches values ​​of 90%. Castor oil proved to be suitable for processing with Ecofining technology, providing a high quality Green Diesel compared to standard biodiesel.

A further objective will be to demonstrate the environmental sustainability of cultivation once in possession of all agronomic data related to the crop, which will reach full maturity after two years. In this case, the cultivation of castor could be scaled-up to obtain a stream of sustainable feedstock for Eni bio-refineries.

**4. Conclusions**

The results of the present study indicate that castor grows well under semi-arid climate conditions in the pre-desert areas of Tunisia, with irrigation input of high salinity water extracted from in-situ excavated wells, even in the presence of poor soils. The oil extracted from collected seeds proved to be a good feedstock for the Ecofining process providing a high quality Green Diesel.

**References**

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