

Economic Perspective on Coproducing Ethanol and Biodiesel from Industrial Hemp

Background/objective

Hemp is highly regarded as a potential feedstock for a sustainable biorefinery due to its agricultural versatility (excellent adaptability to a wide range of agro-ecological conditions and can be grown on marginal lands) as well as oil and carbohydrate production capability (high biomass and oil yields). Here, the economics of producing biofuels from both real and theoretical industrial hemp plants were examined using software to model a lignocellulosic biofuel plant and answer some of big picture questions from CABBI: the cost of producing biodiesel and bioethanol from a lignocellulosic feedstock, and the total biodiesel production per hectare of agricultural land.

Approach

- ❖ Biomass from five hemp genotypes was analyzed for lignocellulosic sugars, ash, lignin, and triacylglycerol (TAG) content. Hemp genotype 19m96136 (19m) was chosen for its high total carbohydrate content (45%) and high maximum plant growth height (221 cm), which imply high carbohydrate yield.
- ❖ The SuperPro Designer® platform was used for process design, simulation, and techno-economic analysis.
- ❖ Since lipid content in the current 19m hemp biomass was low, its composition data was used to develop three different biomass composition scenarios/test cases with 2, 5, and 10% lipids and assumed a portion of the carbohydrate fraction in the biomass was replaced by lipids.

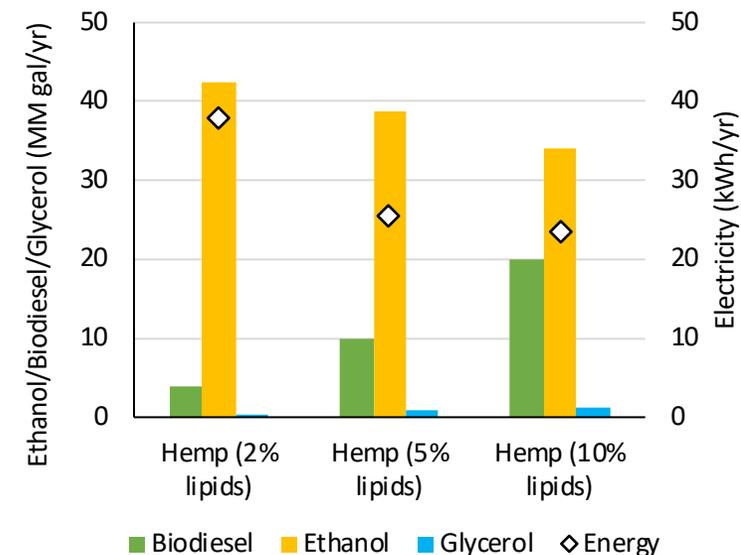
Results

- ❖ Every metric ton of hemp biomass containing 2% lipids can yield: 5.86 gallons (22.19 liters) of biodiesel, 63.30 gallons (239.48 liters) of ethanol, 0.44 gallons (1.66 liters) of glycerol, and 56.50 kWh energy.
- ❖ Hemp plant biomass with 10% lipids can produce biodiesel at \$4.31/gallon, comparable to soybean biodiesel.
- ❖ Total biofuels produced per hectare of land with 19m hemp was between 437.80 and 455.82 gallons.
- ❖ Based on biofuel yield per agricultural land area as well as economic value, hemp biomass is more favorable than soybean.

Significance

The study shows hemp can be a promising bioenergy crop, producing biodiesel at lower price than soybean in addition to ethanol production. It also demonstrates the importance of understanding the lipid metabolism in plant cells and research need of improving lipid accumulation in vegetative tissue.

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Annual production of biofuels (ethanol and biodiesel) and coproducts (glycerol and energy) from varying lipid-containing hemp biomass.