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# FINAL REPORT: BIODIESEL PRODUCTION FROM HIGH OIL YIELD PEANUT CULTIVARS

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Objective 1: **Identification of Optimal Peanut Cultivars**

Based on known agronomic and chemical properties nine peanut cultivars were selected and grown in limited quantities on National Peanut Laboratory farms for this study. The varieties selected are as follows: C11-2-39, DP-1, GA Brown, GA Green, GA02C, GA01X, FR458TX, AT201, and AP3. The first three cultivars listed have promising attributes which may make them prime candidates for Biodiesel feedstock production.

C11-2-39 or "Georganic" from the Holbrook laboratory is a low input, long season variety which requires no fungicide. This can save up to $100/acre in production costs. As the intent with any peanut grown for Biodiesel is to go straight to crush without sorting or grading, this cultivar could facilitate an inexpensive system for obtaining high volumes of oil for fuel production

DP-1 has resistance to Leaf Spot and TSWV. Like the disease resistance found in C11-2-39 these qualities decrease overall production costs. The major benefit of this variety to the Biodiesel market however lies in its relatively high yield (~4000lbs/acre) combined with its relatively high oil yield (~54%). The combination of these three factors makes this variety a very promising candidate for peanut based Biodiesel production systems.

GA Brown is a high yield peanut (~5000lb/acre) with moderate disease resistance. The advantage of this variety beyond its high yield is its undesirability in the food market. The small kernel of this cultivar resulted in its designation as a Spanish variety and its exclusion from the high value segments of the food market. This however is a benefit to an industrial peanut such as the one we are developing here as it will not compete with the food market and can then retain a lower value per volume allowing more economic extraction of oil and its subsequent use as a biodiesel feedstock.

The other varieties selected are commonly grown in the US and were chosen to allow the identification of a cross section of Biodiesel properties from traditional peanut cultivars. Investigation of common cultivars will aid in the development of a database of peanut oil fuel properties which could be used to select optimum varieties in the case of extreme fuel prices.

The original intent of this study was to identify peanut varieties with high oil yield which could provide oil feedstock for Biodiesel production. Further analysis of the situation led to the conclusion that the ultimate goal of this study should be to identify cultivars which could deliver the highest oil yield per dollar. That is, we are not necessarily looking for the peanuts which provide the most oil per kernel or even per acre. The most promising peanut cultivars are those that require lower inputs and require less processing before oil is extracted. Additionally, non-competition with the food market through the development of an industrial peanut oil market will also aid in developing peanuts as a renewable, domestic source of fuel for the United States.

A preliminary economic analysis was performed with Dr. John McKissick, an agricultural economist at the University of Georgia. Preliminary numbers show that processing costs associated with peanuts, specifically shelling and sorting, negatively affect the economic potential of peanut Biodiesel. Development of new processing methods specifically to optimize oil collection will have to be explored along with optimizing peanut oil yields per acre and more importantly, producing oil at the lowest price per gallon. Additionally, the high value of peanut oil in the food market can be up to twice that of soybean oil, the main feedstock used for Biodiesel production in the United States. Biodiesel feedstock development programs such as this one need to take into account the necessity of keeping feedstock costs near that of the primary source of Biodiesel in order to provide a competitively priced product.

Objective 2: **Preparation and Analysis of Biodiesel from Selected Cultivars**

Peanuts of each selected type were harvested following traditional practices. Varieties were pressed for oil using a CeCoCo small scale cold press extruder located at the National Peanut Laboratory. Approximately 3 gallons of crude oil from each variety were obtained. 100% Peanut oil based Biodiesel was prepared in a 15 gallon Biodiesel reactor constructed by the UGA research team. A cone bottom tank was fitted with an extended ring stand built in the UGA engineering shop. A sight glass was constructed with two valves to control the flow of glycerol byproduct, product and waste streams. Agitation was accomplished by modifying the lid of the reactor to accommodate a variable speed electric drill fitted with a mixer. A preliminary 3 gallon batch of peanut Biodiesel was made to determine procedure and reactant quantities. Each 3 gallon batch was made using 3 gallons of peanut oil, 0.6 gallons of Methanol and 3.5 oz of Potassium Hydroxide catalyst. Catalyst and methanol were mixed for 15 minutes using a stir plate; this mixture was then added to the main reactor containing the peanut oil. The reactants were mixed for 2 hours under constant, vigorous agitation. The mixture settled for 24 hours and the glycerol byproduct was drained. The product was washed twice with 1 gallon of water mist. Washes were allowed to settle for 48 hours and waste water was drained. Alkalinity of the Biodiesel was monitored until the pH reached near 7.0 at which time the product was ready for use. No major complications were encountered during processing of peanut oil to Biodiesel and final product had adequate energy and viscosity values.

Initial problems were encountered using crude peanut oil as the lack of refining, bleaching and/or deodorizing appeared to cause complications in the production of Biodiesel. A white precipitate was formed during the production of Biodiesel which proved very difficult to remove. Ultimately, after careful washing this substance was eliminated from the fuel. It is to be characterized for a new National Peanut Board study which is currently underway. It is suspected this material is made up of gums, long chain, saturated fatty acids, or soaps. In any case, this problem is being addressed and methods for eliminating this problem and streamlining Biodiesel production from crude oil are being developed.

**Conclusion**

This preliminary study confirms that Biodiesel derived from peanut oil can provide an adequate fuel for modern diesel engines. At this time, the potential for innovative peanut varieties to provide a significant source of oil for the production of this fuel is dependent upon the economic feasibility of these systems. A new study is currently underway working with Dr. John McKissick and the Center for Agribusiness to determine the economic feasibility of different Peanut based Biodiesel models. This study is also further examining the fuel properties of the fuels examined here and will ultimately include comparative engine tests of these fuels with both bio-based and petroleum based commercial diesel fuels.