Soil fertility as a limiting economic factor for sustainable biodiesel feedstock production

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Abstract

Sustainable production of biofuel feedstock encompasses social, environmental and economic issues that often overlap. In Florida, concerns over replacing food production with fuel production and the accelerated loss conservation and riparian easements can be mitigated through the integration of feedstocks into existing horticultural production systems. In this capacity, the feedstock functions as a beneficial rotational crop that mitigates the build-up of soil-borne pest population, a provider of additional organic matter for future crop production and a local source of feedstock for biodiesel. However, crop budgets derived from multiple years of data indicate that soil fertility is the major limiting economic factor affecting production. Research has been initiated to improve soil fertility by short and long term approaches to crop production. Long term approaches include changes in land management practices that promote the cultivation of locally adapted nitrogen fixing cover crops. Short term approaches include the modification of application equipment to optimize application of synthetically derived sources of nitrogen. This poster reports on the progress of this research.

Introduction

Rotation crops that provide feedstock oil for biodiesel production offer the potential for creating additional revenue sources for farmers at the same time that large regional truck and bus fleets are seeking more sustainable local biodiesel sources. Biodiesel is a non-petroleum-based diesel fuel produced from the transesterification of vegetable oil or animal fat. Unlike straight vegetable oil, biodiesel has combustion properties very similar to petroleum diesel and can be freely substituted for petroleum diesel in many uses (U.S. Dept. of Energy 2004). In Florida, an enormous market for locally generated biodiesel exists. Since 2004, annual consumption of petroleum diesel in Florida has remained above 1.6 billion gal per year (McDonald and Albanese 2008) while nationally, estimates of U.S. biodiesel production are closer to 700 million gal per year (Anonymous 2008). Locally produced biodiesel feedstocks are less prone to oxidative destabilization (rancidity) caused by lengthy storage and transportation conditions, thus providing a higher quality biodiesel product. Further, large regional fleets are seeking to support the local rural communities and source more sustainable biodiesel feedstock to reduce energy lost in transporting fuel while at the same time lowering their overall carbon footprints

Cultivation of sunflower in Florida as a rotational crop to complement existing horticultural production systems has the potential to provide supplementary revenue streams for rural economies, improve soil fertility, sequester additional carbon from the atmosphere, and provide a local supply of renewable fuel that does not compete with food production. These criteria improve the social sustainability of sunflower production. However, breakeven costs for harvested seed or expelled oil are still to high to sustain local production. This study developed and examined a crop budget to identify variable costs that limit economic production and then initiated research to address the limiting factors.

Methods

Crop budgets for sunflower production were derived from published research and from additional field trials initiated locally. Major factors contributing to the variable costs were identified and prioritized. Field research trials were initiated to develop short- and long-term solutions to reduce variable input costs and make production more economically and environmentally sustainable. Long-term solutions consisted of the identification and integration of indigenous legume varieties into local crop production systems. Short term solutions included the modification of fertilizer formulations, applications and incorportation methods.

Results

Sunflower budget projections and breakeven costs were estimated at several production scales for a yield of 2016 kg/ha with a net return of 869 liters/ha. For an 80 ha production size, breakeven costs were estimated at $0.30 US 0.4/kg of harvested seed. Examination of the crop budgets indicated that greater than 60% of the variable costs were due to fertilizer applications. Additional field experiments were established to investigate the contribution of an indigenous legume (*Aeschynomene americana*) to soil fertility and to minimize supplemental fertilizer applications through improved technology.

References

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