

Delaware Sea Grant Project:

Sustaining ecological and economic services of coastal land resources during sea level rise (R/ECO-5)

Investigators:

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Project Abstract:

The goal of this project is to provide a means of sustaining ecological and economic services of coastal land resources during sea level rise by introducing the “mariculture” of a marsh plant into the transitioning ecotone between fast ground and wetlands. The transition begins when the first storm tides bring salt to the low-lying farmland, or when aquifers or other water sources for irrigation become brackish, and ends when the soils are too wet or saline to be arable. As sea level rises, it will be necessary to retreat in many locations. Because much of the coastal land area surrounding the bays in Delaware and the mid-Atlantic region is agricultural, there is an opportunity to develop management plans for these coastal areas that consider both ecological and economic services. Our goal is to maintain economic viability of the agricultural land for as long as possible after salinity has started to affect the soils, while at the same time growing a plant that will facilitate marsh development when tidal flooding makes it mechanically impossible to farm the land. We propose growing the salt-tolerant marsh plant, seashore mallow (*Kosteletzkya virginica*), as an oil and feed crop. This plant produces seeds that contain 18-20% oil with a fatty acid profile similar to that of cottonseed oil. Like cottonseed oil, seashore mallow seed oil has properties suitable for biodiesel production and the high-protein residual meal is also a potential animal feed. Seashore mallow is a perennial plant and therefore is sustainable without the energy input necessary for the yearly planting of traditional oil-seed crops. As a marsh plant, it is flood-tolerant and its deep root system makes it drought-tolerant as well. The architecture of the canopy lends it to being harvested by traditional farm machinery. The land will remain agriculturally and economically viable for a longer period of time than if no such halophytic crop is planted while maintaining a buffer between the farmland and the marsh fringing the bay.

In addition to the economic benefit of a salt-tolerant crop, planting a buffer of seashore mallow in transitional agricultural lands will provide many ecosystem services that will ultimately facilitate the establishment of marsh vegetation. Seashore mallow fields would form a buffer that prevents erosion, filters nutrients, and stores carbon. Because of its canopy and root system structure and function, seashore mallow will improve physical and chemical soil properties of saltwater-affected soil by increasing aeration, regulating soil temperatures, increasing organic matter content, and ameliorating increased salinity due to evaporation. These ecosystem services on land that would otherwise be barren will facilitate the establishment of other desirable marsh plant species as sea level rise results in farmland inundation.

The six specific objectives of the proposed project are to: 1) Determine how seashore mallow mediates soil properties (such as soil salinity, cation exchange capacity, infiltration, and soil carbon and nitrogen) and facilitates salt marsh vegetation establishment during transition from farmland to marshland; 2) Assess competition between seashore mallow and the potential marsh

colonizer, *Spartina patens*; 3) Examine the seashore mallow perennial root system carbohydrate and nutrient management as they relate to sustaining production with minimal input; 4) Maximize harvest efficiency of seashore mallow to provide sufficient seed as part of developing a marketable product for future expansion by growers, thus making managed transition from farmland to marshland possible; 5) Compare oil extraction methods for seashore mallow seed and evaluate the oil for the production of biodiesel fuel and other bio-based products. Likewise, evaluate the residual meal for use in animal feed; and 6) Initiate a selection and breeding program and develop a simplified tissue culture protocol for seashore mallow for future crop improvement.

This project will bridge the gap between research and plant commercialization. It is crucial to develop this crop quickly, to begin this ecologically sound management practice in areas which have already become salinized. If left barren these areas provide few ecological services and remain inviting habitat for invasive species. The success of the strategy depends on two actions - proper management of the succession from traditional crop through halophyte crop to wetland and sufficient development of the halophyte crop, seashore mallow, to make it attractive to the biofuels/bio-based products/feed industry and the growers. Both the ecological and economic portions of the concept are interdependent and must be developed in concert.