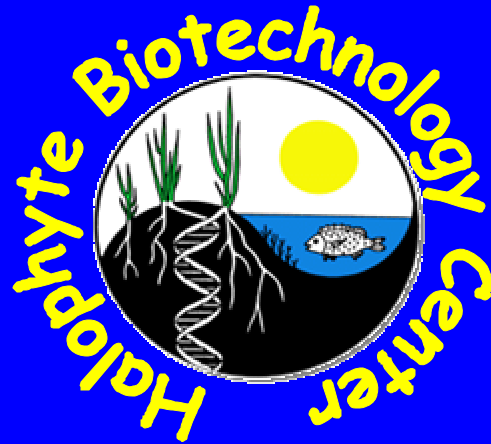


An Oil-Seed Biofuel Multi-Use Crop Grown with Seawater



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Meet the Plant

Kosteletzkya virginica

- Seashore Mallow
- Malvaceae
- Relative of cotton & okra
- Delaware to Florida and the Gulf of Mexico coast
- Self or cross-pollinated



Seashore Mallow Features

- **Perennial**
- **Grows with saltwater irrigation**
- **Morphology similar to soybean**
- **~18% oil for biodiesel**
- **Residual seed meal ~30% protein**
- **Cellulosic stems for biofuel**
- **Large fleshy roots sequester carbon and contains gums**
- **Grown with traditional farm equipment**



What makes this plant a good candidate for the feedstock list ?

- Uses land and water resources not suitable for traditional crops.
- Requires minimal energy input.
- Grows near coastal population centers.
- Has multiple useful products.

Uses land and water resources not suitable for traditional crops.

- This mallow evolved in the saline, often saturated, soils of the coastal wetlands.

Salt damage from high tides.



- Completes life cycle at coastal ocean salinity.



- Seed production enhanced in the presence of salt.



Requires minimal energy input.

- No-till planting
- Long-lived Perennial
- Saline water suppresses weeds
- Stored carbon reserves close canopy quickly when regrowth begins
- Deep root system taps water low in the soil profile

Planting Seashore Mallow in a no-till setting on the Freeman farm in Sussex County, Delaware.



Planting in tilled sandy loam on the same farm.

















SEED YIELDS

Bushels per acre

**Soybeans
(2003-2004)**

**Seashore
Mallow**

DE	36	42	~ 22
GA	33	30	
IA	32	49	
SC	28	27	

Grows near population centers.

- Coastal fields where sea-level rise is flooding fields with saline water (east coast U.S.)
- Coastal deserts that could be irrigated with saline water (Pakistan)
- Soils where either riverine or well irrigation water is contaminated by salt water intrusion and salt-wedge movement upstream (coasts where sea level rise or water use depletes resources)

- New coastal soils claimed from the sea (China coast)
- Inland arable fields degraded during irrigation (CA)
- Dry lands with brackish aquifers (Egypt)
- Saline soil with seasonal rainfall (Thailand)
- Non-saline upland soils, especially light droughty soils where irrigation is not available.

Products from Seashore Mallow

Biodiesel -
Oil from the seeds

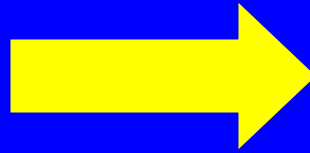


Sodium Accumulation in Seeds

Seed	Na	K	Ca
Seashore Mallow	15	1248	205
Great Northern	19	1196	144
Soybean	5	1677	226
Barley, pearled	3	160	16

(Islam, et al. 1982)

(data are reported in mg per 100 g)



Oil Comparison

	<u>% Oil</u>
Soybean	18-20
Seashore Mallow	15-20
Cottonseed	18

Characteristics and Composition (%) of Three Seed Crop Oils

<u>Fatty acid</u>	<u>Seashore Mallow</u>	<u>Cottonseed</u>	<u>Soybean</u>
14:0	0.1	1.4	0.1
16:0	24.1	23.1	9.8
16:1	0.6	2.0	0.4
18:0	1.0	1.1	2.4
Malvalic	1.8	1.5	-
18:1	13.7	22.1	28.9
18:2	55.2	47.8	50.7
18:3	0.8	-	0.5
Sterculic	0.5	0.5	-
20:0	0.9	1.3	0.9
22:0	0.9	-	-
24:1	1.9	-	-
<i>Specific gravity</i>	0.92	0.93	-
<i>Iodine value</i>	102	105	130
<i>Saponification no.</i>	191	194	191

Additional Products

- Feed Meal
 - Mash remaining after oil extraction

<u>Amino acid</u>	<u>mg/g N</u>	<u>Amino acid</u>	<u>mg/g N</u>
Asp	598+	Val	199*
Thr	224	Ile	175
Ser	321	Leu	357
Glu	1045+	Tyr	187
Pro	230	Phe	283
Gly	336	Tot.arom-AAAs	470
Ala	261	His	172
Cys	166	Lys	278
Met	93	Arg	657+
Tot.S- AAs	259	Try	258

***limiting amino acid, + also the most abundant AAs
in cottonseed**

Cellulose from stems for biofuel



Single stem first year, multiple stems subsequent years (average 4 in year 2)



Carbon Sequestration

Larger roots
penetrate at least
60 cm in sandy
loam soil after the
first year's
growth.





Genetic improvement

