



Sunray Venus Clam Culture: Results of Land-based Nursery, Field Nursery and Growout Trials in Florida

Leslie N. Sturmer

University of Florida IFAS

John Scarpa

Harbor Branch Oceanographic Institute at FAU



Objectives

- Utilize current hard clam methods as a starting point to:
 - 1) Examine nursery culture**
 - Land-based and field
 - 2) Evaluate field culture methods for growout**
 - 3) Document survival and growth in culture systems**

Funded by Florida Sea Grant R/LR-A-44, 2006-8

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Land-based nursery

- Distribute seed to industry partners to nurse in commercial settings
 - Upwellers
 - FLUPSYs
- Rear in replicated trials at UF Shellfish Facility
 - Downwellers
 - Raceways
 - Tanks / trays
- Examine the following
 - Various systems
 - Stocking densities
 - Seasonal /annual differences



In 1-3 months after setting, depending on feed and temperature, post-set sieved on 1.0-1.2 mm screens

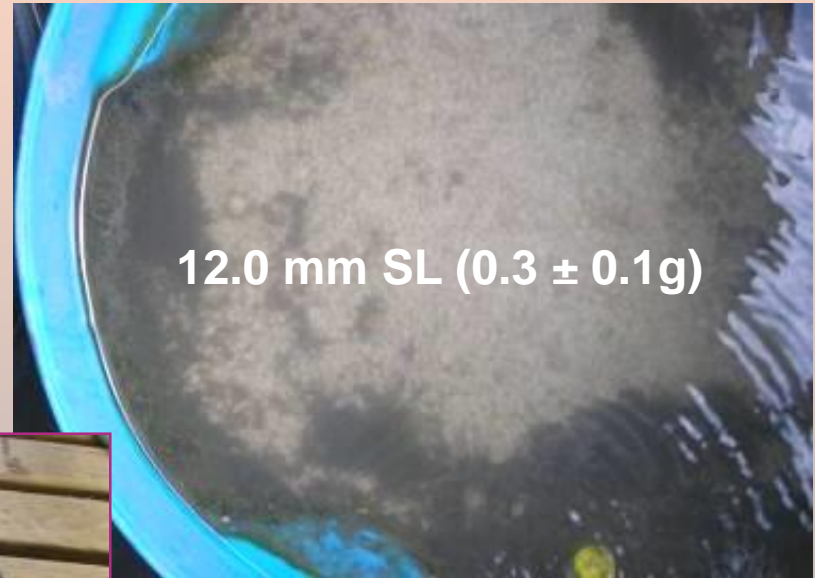
Size: 275-500/mL, 1.2-1.5 mm shell width, 3.3-4.0 mm shell length

Land-based Nursery Rearing, 2007

Juveniles (>2.0 mm sieved seed, 37/ml, 6.0 mm SL)) moved to land-based nurseries on east coast. Reared in upwellers and FLUPSY at 1,600/ft² for 4-5 months.



Upweller without substrate



12.0 mm SL (0.3 ± 0.1 g)



20.4 mm SL (1.1 ± 0.3 g)

Bin with substrate (10" sand)

Addition of substrate was advantageous, but could be problematic if allowed to go anaerobic.

Land-based Nursery Rearing, 2008



**Downweller bins with distributor bar
running down length of tank**

No substrate added

- July Trial
 - >3.0 sieved seed, 6.5 mm SL
 - Stocking densities
 - 1000, 2000, 3000 per ft²
 - High mortalities after few weeks
- October Trial
 - >3.0 sieved seed, 6.5 mm SL
 - >2.0 mm sieved seed, 2.5 mm SL
 - Stocking densities
 - 2000, 3000, 4000 per ft²
 - After 9 weeks
 - Slow growth
 - 5-15% sieved up on >4.0 screen
 - 66-69% survival



Land-based Nursery Rearing, 2009

- September Trial
 - >1.2 sieved seed, 294/ml, 6.5 mm SL
 - Raceway tanks with laminar flow
 - Stocking densities
 - 1000, 2000 per ft²
 - Trays inside laminar flow raceways
 - Stocking densities
 - 1000, 1500, 2000, 2500 per ft²
 - Reared for 7-8 weeks (53-55 days)



Land-based Nursery Rearing, 2009

Results ranged from 7.4-8.9 mm SL, 85-91% survival.

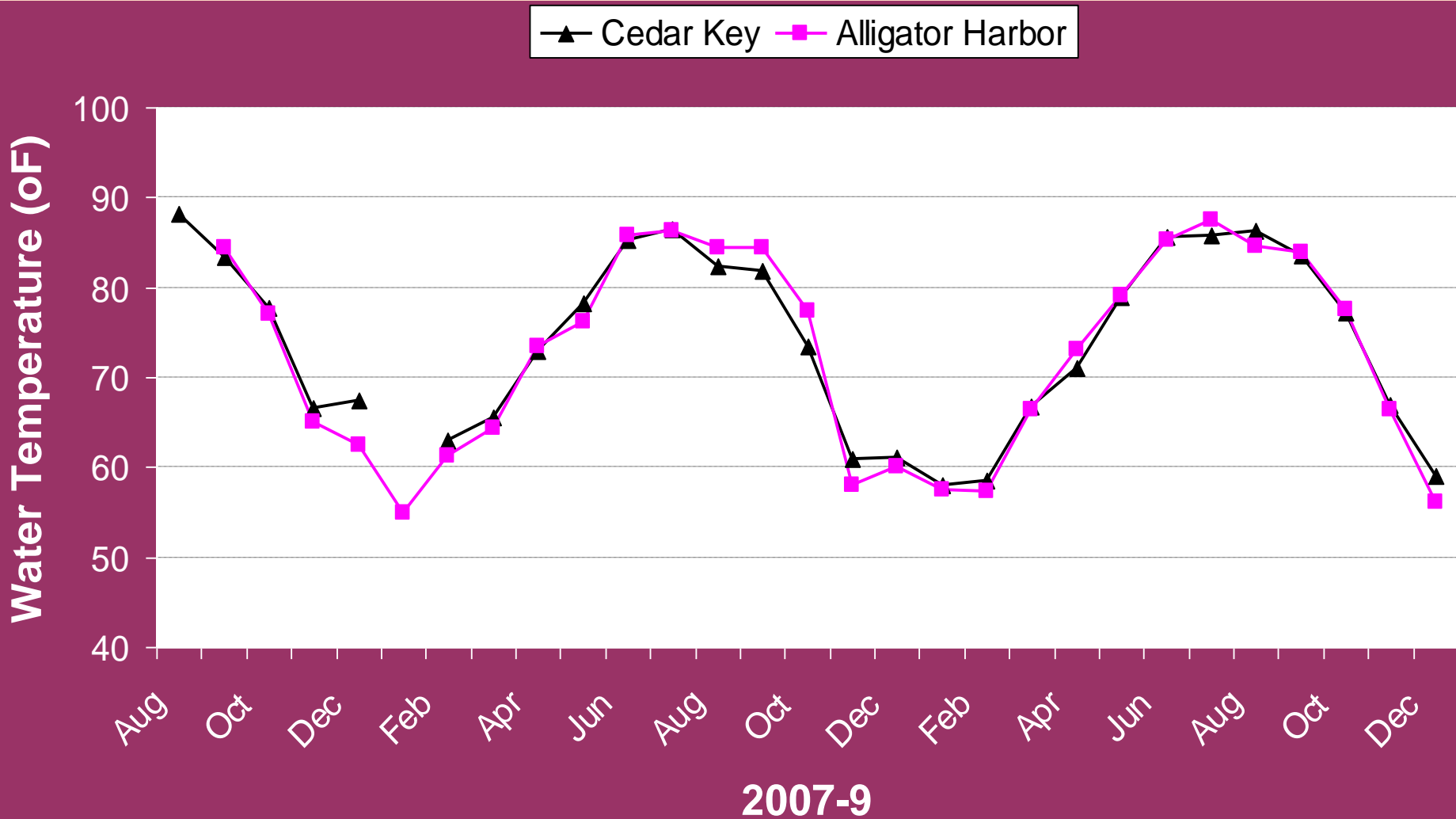
| System | Density (# / ft ²) | # Reps | Ave SL (mm) | Ave Survival (%) | % Sieve >4.0 mm | % Sieve >3.3 mm |
|--------|--------------------------------|--------|-------------|------------------|-----------------|-----------------|
| Tank | 1000 | 2 | 7.4 | 84.6 | 53.2 | 26.3 |
| | 2000 | 2 | 7.3 | 89.0 | 46.9 | 25.2 |
| Tray | 1000 | 3 | 8.9 | 88.9 | 79.1 | 14.1 |
| | 1500 | 3 | 8.4 | 91.0 | 75.0 | 15.4 |
| | 2000 | 3 | 8.3 | 87.8 | 74.7 | 15.3 |
| | 2500 | 3 | 8.1 | 88.3 | 69.9 | 17.5 |

Statistical analyses conducted with SAS using general linear model, statistical differences considered significant if $P < 0.05$.

Field Nursery and Growout Trials, 2007-2010

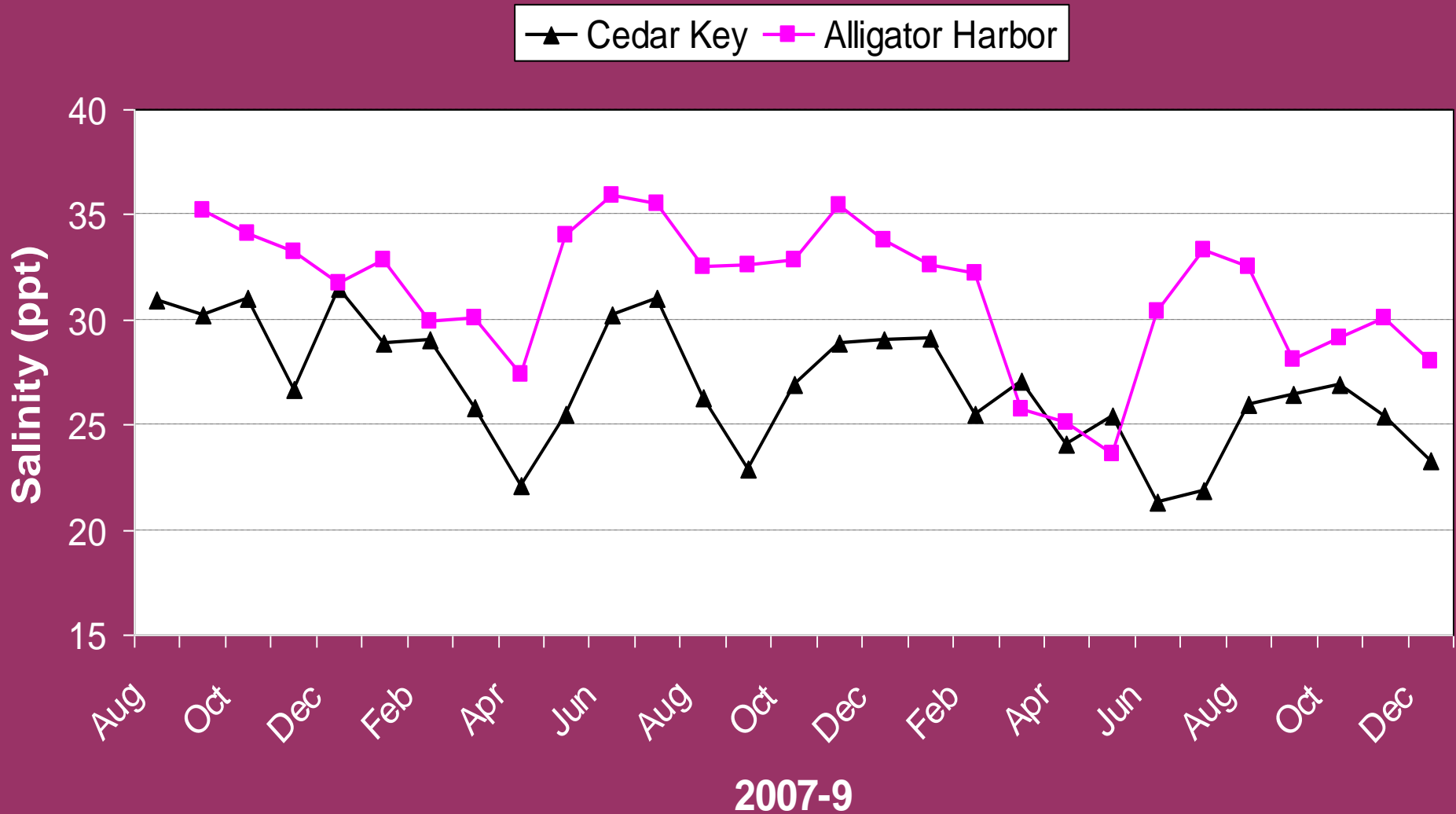


Temperature (°F), Monthly Averages



Water temperature measured every 30 minutes with YSI 6600 data sonde

Salinity (ppt), Monthly Averages

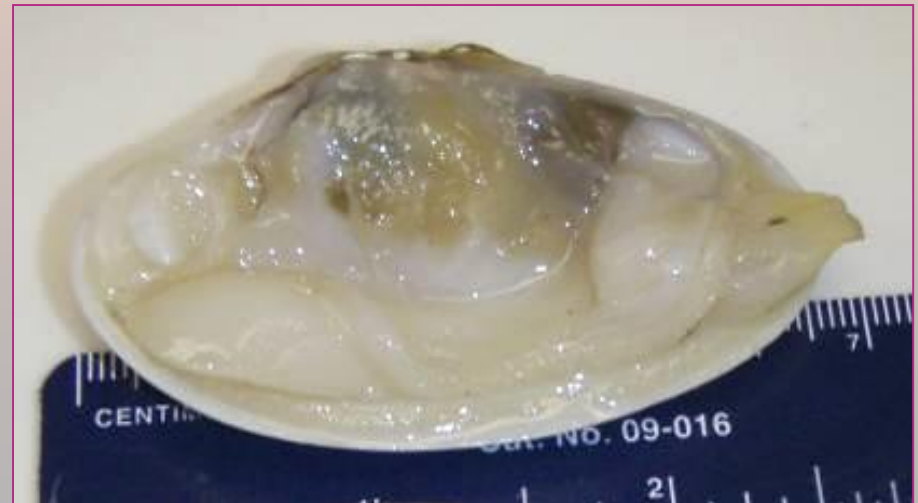


Salinity measured every 30 minutes with YSI 6600 data sonde

Sampling and Measurements

Characteristics measured:

- Survival
- Growth – length, width, height
- Weight – total, meat (wet, dry)
- Condition index*
- Histology



*Ratio of dry meat:dry shell x 100 (Fernandez *et al.* 1999)

Field Nursery Trials – Bottom Cages



Bottom cages (3' x 1.5' x 6" deep) constructed of wire and lined with 4 mm polyester mesh material

- Stocking densities, 100-375/ft²
- Seed sizes, 12-18 mm SL
- Duration, 42-106 days (6-15 wks)





Field Nursery Results, 2007

Bottom Cages

| Site* | Sieve (mm) | Density† (#/ft ²) | # Days | Survival (%) | Shell Length (mm) | Growth (mm/day) |
|-------|------------|-------------------------------|--------|--------------|-------------------|-----------------|
| AH | >9.0 | 100 | 42 | 69.3 | 26.8 | 0.20 |
| AH | >9.0 | 200 | 42 | 94.3 | 27.6 | 0.22 |
| AH | >6.7 | 222 | 78 | 70.3 | 27.5 | 0.18 |
| CK | >6.0 | 328 | 106 | 81.8 | 26.2 | 0.14 |

*AH – Alligator Harbor CK – Cedar Key

† Density used in hard clam nursery bags is 625/ft²

Field Nursery Trials – Bottom Bags



*Bottom bags (3' by 4' and 4' by 4')
made of 4 mm polyester mesh material*

- Stocking densities, 330-555/ft²
- Seed sizes, 9-14 mm SL
- Duration, 78-113 days (11-16 weeks)



Field Nursery Results, 2007

Bottom Bags

| Site | Sieve (mm) | Density (#/ft ²) | # Days | Survival (%) | Shell Length (mm) | Growth (mm/day) |
|------|------------|------------------------------|--------|--------------|-------------------|-----------------|
| AH | >6.7 | 330 | 78 | 78.3 | 22.8 | 0.12 |
| AH | >5.0 | 555 | 106 | 31.6 | 26.9 | 0.17 |
| CK | >4.0 | 440 | 113 | 90.1 | 23.8 | 0.13 |

Density used for stocking hard clams in a 4' x 4' (16 ft²) nursery bottom bag is 625/ft²



Field Nursery Results, 2008-9

Bottom Bags, Cedar Key

| Plant Date | Sieve (mm) | Density (#/ft ²) | # Weeks | Survival (%) | Shell Length (mm) | Why? |
|------------|------------|------------------------------|---------|--------------|-------------------|-------------------------|
| Aug '08 | >5.0 | 310-355 | -- | low | -- | TS Fay, 17 ppt salinity |
| Dec '08 | >4.0 | 335-375 | 32 | 17.4 | 24.2 | Poor seed quality |
| | >3.3 | 335-400 | 32 | 0 | -- | Poor seed quality |
| May '09 | >6.0 | 505-575 | 12 | 66.3 | 19.5 | Good temps and salinity |

Density used for stocking hard clams in a 4' x 4' (16 ft²) nursery bottom bag is 625/ft²

Growout Trials – Bottom Cages

*Bottom cages (3' x 3' x 6" deep)
constructed of 1" vinyl-coated wire*



- Stocking densities, 43-56/ft²
- Seed sizes, 26-27 mm SL
- Duration, 340-476 days
(11.2-15 months)



Growout Results, 2007-8

Bottom Cages

| Site | SD* (#/ft ²) | # Reps | # Days | Survival (%) | SL, mm (“) | SW, mm (“) | Total Wt, g (#/lb) |
|------|-----------------------------|-----------|-----------|-----------------|------------------|------------------|--------------------------|
| AH | 51 | 4 | 476 | 28.4 | 64.7 (2.6”) | 24.2 (1.0”) | 36.7 (12/lb) |
| CK | 43 | 3 | 340 | 76.7 | 64.5 (2.6”) | 22.9 (0.9”) | 33.9 (13/lb) |
| CK | 56 | 3 | 340 | 59.9 | 62.9 (2.5”) | 22.3 (0.9”) | 32.4 (14/lb) |

Densities used for stocking hard clams in growout bottom bags (4'x4', 16ft²) range from 50-75/ft²

Growout Trials – Bottom Bags



- Alligator Harbor (AH)
- Stocking densities, 38-70/ft²
- Seed size, 27 mm SL
- Duration, 396-476 days (13-15.6 months)



Bottom bags (4' x 4', 16 ft²) made of 9 mm polyester mesh material

- Cedar Key (CK)
- Stocking density study (n=9)
 - Low, 600/bag, 38/ft²
 - Medium, 800/bag, 50/ft²
 - High, 1000/bag, 63/ft²
- Seed size, 24 mm in SL
- Duration, 372 days (12 months)

Growout Results, 2007-8 – Bottom Bags

| Site | SD* (#/ft ²) | # Reps | # Days | Survival (%) | SL, mm (inches) | SW, mm (inches) | Total Wt, g (#/lb) |
|------|-----------------------------|-----------|-----------|-----------------|-----------------------|-----------------------|--------------------------|
| AH | 38 | 2 | 476 | 24.2 | 45.6 (1.8") | 18.6 (0.75") | 14.5 (31/lb) |
| AH | 50 | 3 | 396 | 38.4 | 56.2 (2.2") | 21.0 (0.8") | 23.4 (19/lb) |
| AH | 70 | 4 | 412 | 58.3 | 48.9 (1.9") | 21.4 (0.9") | 23.4 (19/lb) |
| CK | 38 | 9 | 372 | 73.1 | 54.4 (2.2") | 22.0 (0.9") | 24.1 (19/lb) |
| CK | 50 | 9 | 372 | 67.2 | 55.3 (2.2") | 22.1 (0.9") | 24.9 (18/lb) |
| CK | 63 | 9 | 372 | 74.5 | 50.3 (2.0") | 21.0 (0.8") | 19.9 (23/lb) |

Growout Trials – Cedar Key



- Bottom bag variations
 - No frame
 - 1" PVC pipe frame inside bag
 - 1 ½" PVC pipe frame inside bag
- Covered with plastic netting and staked with PVC pipe
- Replications, 3 bags per method
- Stocking density, 44/ft²
- Seed size, 26 mm in length
- Duration, 377 days (~12 months)

Bottom Bag Results, 2007-8 Cedar Key



| Bag Type | Survival (%) | Shell Length, mm (inches) | Shell Width, mm (inches) | Total Weight, g (#/lb) | Dry Mt Weight (g) |
|--------------|--------------|---------------------------|--------------------------|------------------------|-------------------|
| No frame | 76.3 | 56.1 (2.2") | 22.7 (0.9") | 26.9 (17/lb) | 1.61 |
| 1" frame | 64.7 | 58.2 (2.3") | 22.3 (0.9") | 29.3 (15/lb) | 1.72 |
| 1 1/2" frame | 75.1 | 58.7 (2.3") | 22.1 (0.9") | 29.2 (15/lb) | 1.61 |

Statistical analyses conducted with SAS using general linear model, statistical differences considered significant if $P < 0.05$.

Bottom Plant, 2008-9

Cedar Key

Seed broadcasted on bottom substrate, covered with 9 mm mesh polyester netting (4' by 8' plants) edged with lead line, and an additional layer of plastic netting staked with PVC pipe.



- Stocking information
 - Density, 52/ft²
 - Seed size, 26 mm length
- Growout duration, 12 months
- Harvest results
 - 53% survival
 - 63 mm (2.5") length
 - 23 mm (0.95") width
 - 33 grams total weight (14/lb)



Sunrays were hand dug at harvest using rakes

Growout Results – Alligator Harbor



- Mortalities attributed to predation
 - Holes in bags, crushed shell in bags, presence of stone crabs
- Deformities or irregularities observed
 - Limited to bottom margin of shell with one shell having excessive curvature resulting in a depression or hole
 - Ranged from 8 to 48% per bag



Growout Results – Cedar Key

- Shell deformities were also noted and quantified
 - 19-22% from bags
 - 1-4% from bags with frames
 - 2% from bottom plant
- Sunray venus harvested from AH and held in cages in CK for several months “grew out” of their shell irregularities





Growout Results, 2009-10 Alligator Harbor, 16 Months

| Culture Unit (n=2) | Survival (%) | Shell Length, mm (inches) | Shell Width, mm (Inches) | Total Weight, g (#/lb) | Shell Deformities (%) |
|--------------------|--------------|---------------------------|--------------------------|------------------------|-----------------------|
| Bag | 48.2 | 54.2 (2.2") | 21.9 (0.9") | 23.8 (19/lb) | 19 |
| Bag – Pump | 62.5 | 53.0 (2.1") | 21.1 (0.9") | 22.2 (20/lb) | 21 |
| Bag – 1" frame | 21.2 | 47.9 (1.9") | 19.2 (0.8") | 17.4 (26/lb) | 10 |
| Bottom Plant | 37.7 | 62.1 (2.5") | 23.6 (0.9") | 33.9 (13/lb) | 8 |

Summary

- Sunray venus were cultured from land-based nursery through field nursery and growout using methods similar to clams.
- Production results were site-specific.
- At one site, commercially acceptable survival and growth rates were obtained.
- Sunray venus do not consistently perform well in bottom bags.
- Where the bag has worked the soils were sandy but not hard packed.
- Shell deformities were most likely gear and substrate related.
- Sunray venus seem to do better at lower densities than those used for clams.
- Sunray venus may require higher and steadier salinities than clams.



Observations

- The sunray venus is a very active clam with a large foot and long siphons.
- The sunray venus is oblong in shape as opposed to the round shape of a hard clam.
- Sunray venus seed must be longer to be retained in sieves used for clams.
 - >3.3 mm sieve: 7 mm SL - Sunray venus
5 mm SL – Hard clam
 - >4.0 mm sieve: 9 mm SL – Sunray venus
6 mm SL – Hard clam
- The shell of the sunray venus is not as thick or as heavy as the hard clam, but it is not brittle.
 - Sunray venus handle well during sieving, stocking, and harvesting. More work must be done evaluating breakage during processing.



Observations

- Harvest sizes of the sunray venus may differ from those typical for the hard clam.

| Clam Species | Shell Width | Shell Length | Total Weight | Meat Weight* (wet) |
|--------------|--------------|--------------|--------------|--------------------|
| Sunray venus | 26 mm (1") | 68 mm (2.7") | 42 g (11/lb) | 11.4 g |
| Hard clam | 25 mm (1") | 48 mm (1.9") | 34 g (13/lb) | 4.4 g |
| Sunray venus | 20 mm (0.8") | 54 mm (2.2") | 21 g (22/lb) | 5.1 g |
| Hard clam | 20 mm (0.8") | 36 mm (1.4") | 16 g (28/lb) | 2.1 g |

- * For the same size clams in terms of shell width, the meat of the sunray venus weighs about 2.5 times more than the meat of a hard clam.





What's next for 2010-12?

- **Eliminate barriers to commercial production of sunray venus by:**
 - 1) Determining production performance for field nursery and growout culture at multiple existing commercial high-density lease areas;
 - 2) Establishing a relationship between soil (substrate) and productivity at multiple lease areas using a soils-based approach;
 - 3) Defining a) salinity and b) soil preferences for selection of future lease sites.

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Growers' Trials, 2010-12



- During July-September 2010, 155,000 growout-size seed distributed to 13 growers at 5 lease areas in 3 counties
 - Franklin County
 - Levy County
 - Lee County
- At planting soil core and H₂S samples taken at each lease
- Samples will also be taken at harvest
- More seed to be distributed to growers in 2011

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