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TAHITI AQUACULTURE 2010
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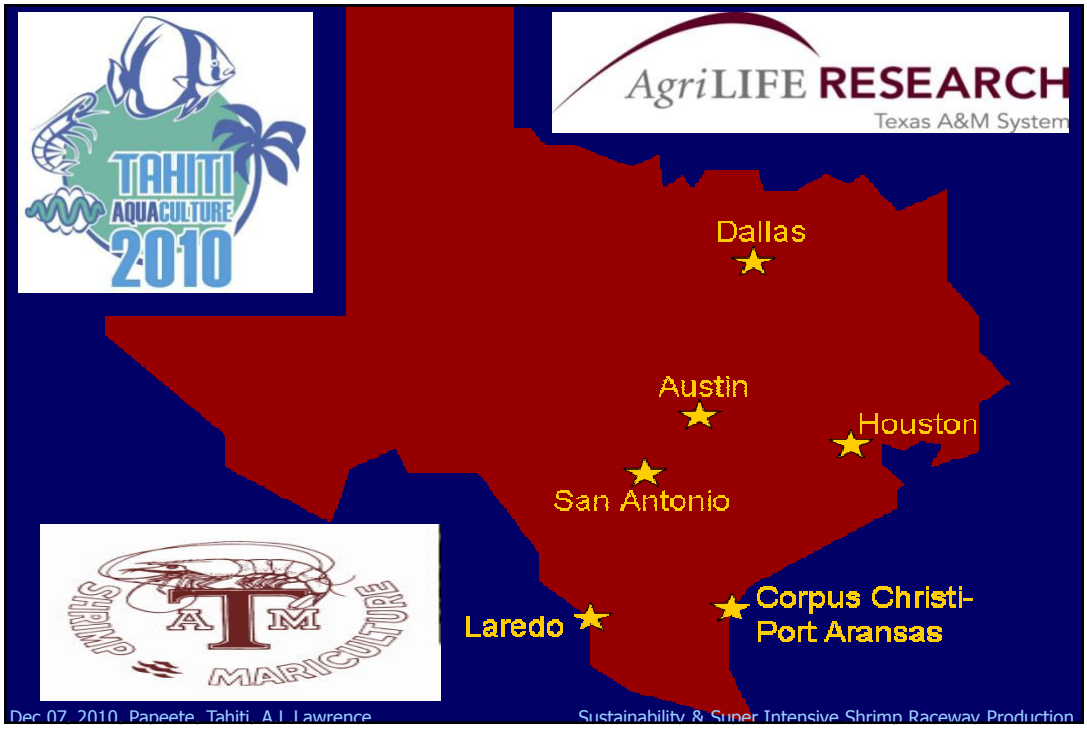
SHRIMP MARICULTURE
Dec 07, 2010, Papeete, Tahiti, A.L.Lawrence
Sustainability & Super Intensive Shrimp Raceway Production


AgriLIFE RESEARCH
Texas A&M System
Super-Intensive Raceway
Shrimp Production
The Road to Sustainability
December 07, 2010
Papeete, Tahiti
TAHITI AQUACULTURE 2010
SHRIMP MARICULTURE
Addison Lee Lawrence
Texas AgriLife Research, Texas A&M System
Dec 07, 2010, Papeete, Tahiti, A.L.Lawrence
Sustainability & Super Intensive Shrimp Raceway Production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Sustainability & Super Intensive Shrimp Raceway Production


Texas AgriLife Research
Mariculture Laboratory
at Port Aransas
Texas A&M System
1300 Port Street
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Some information in this presentation is U.S Patent Pending with international filing (Patent Cooperation Treaty)

Worldwide license to:

ROYAL CARIDEA, LLC

Production (kg/m^3/year)
(2 to 3 crops/year, > 20 gm/shrimp)

Extensive	< 0.3
Semi-extensive:	.25 – 1.2
Semi-intensive:	1.0 – 3.0
Intensive:	2.5 – 7.5
Super intensive:	24 – 60 (240,000 to 600,000 kg/ha/year)

Status, US Cultured Shrimp Production

- US shrimp pond production during 1990's was healthy and growing at 5% to 10% per year
- Semi-intensive production of 5 to 10 mt/ha/crop but only one crop/year
- Cannot compete with year round production in tropics
- Today, US shrimp pond production is about 50% of what it was in 2000

Super-Intensive Shrimp Production Inside Buildings Commercial Requirements for United States

- Survival above 80%
- Growth rate above 1.5 gm/week
- Production level above 10 kg/m^3 /crop or 20 to 25 kg/m^3/year (200 to 250 metric tons/ha/year)
- Production of >20 gm/shrimp

SUSTAINABILITY and Super-Intensive Shrimp Production

- Land and Water use
- Growth and Survival
- FCR (feed management and quality)
- Inland farms
- "ORGANIC" concept

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Super-Intensive Shrimp Raceway Production Based on New Technology in Following Areas

- New genetically selected high growth lines, *L. vannamei*
- New complete high nutrient density feeds
- New feed management strategy
- New raceway management method

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Performance of Two High Growth Lines of *L. vannamei* in Response to Different Dietary Protein Sources and Levels

Hui Gong, Addison L. Lawrence, Frank Alig, Donghuo Jiang

WAS, Busan, Korea, 2008

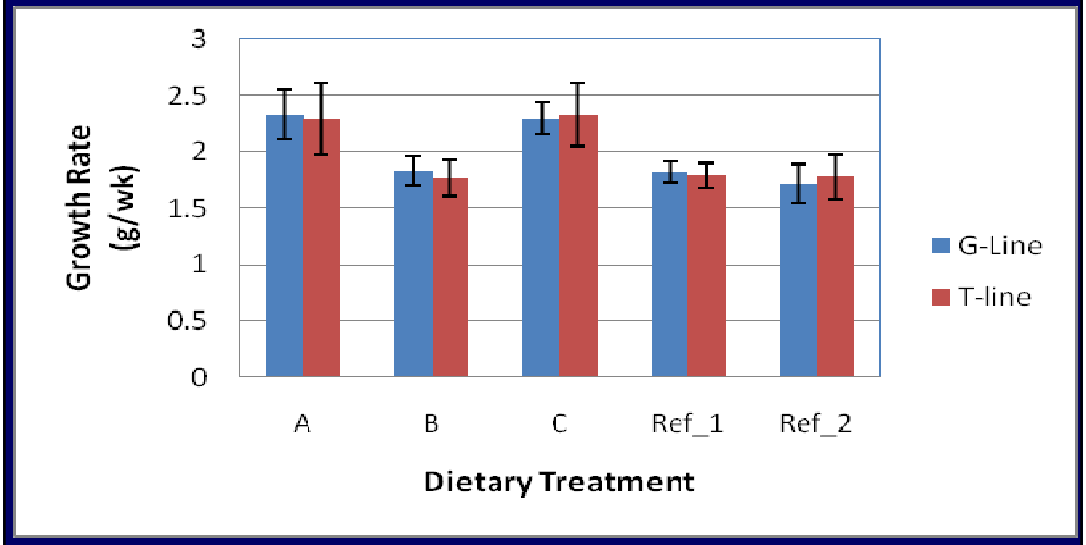
College of Natural & Applied Sciences
University of Guam
Texas AgriLife Research, Texas A&M System

Experimental Diets

3 semi-purified diets and 2 commercial diets (Rangen 35/0 and 40/5) as references

Diet	Dietary Protein (%)	Soybean Inclusion (%)	•Fish Meal Inclusion (%)	Squid M. Inclusion (%)
A	35	7.9	15.0	15.0
B	20	0.0	11.3	11.3
C	35	16.7	11.3	11.3
Ref. 1	35	N/A	N/A	0.0
Ref. 2	40	N/A	N/A	5.0

Growth Rate vs. Dietary Treatment



❖ Shrimp growth from 1.72 to 2.33 g/wk

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RESULTS

- 8 week growth trial, 82-87% survival
- 104/m^3 initial stocking density
- Initial size: 10.3 to 10.5 g/shrimp
- Final size: 24.1 to 29.2 g/shrimp
- 1.71 to 2.33 g/week growth rate
- 2.23 to 2.49 kg/m^3 final biomass

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Use of Bioflocs as an Ingredient in Shrimp Feed

David Kuhn, Greg Boardman, Addison Lawrence, Lori Marsh, George Flick Jr.

VirginiaTech
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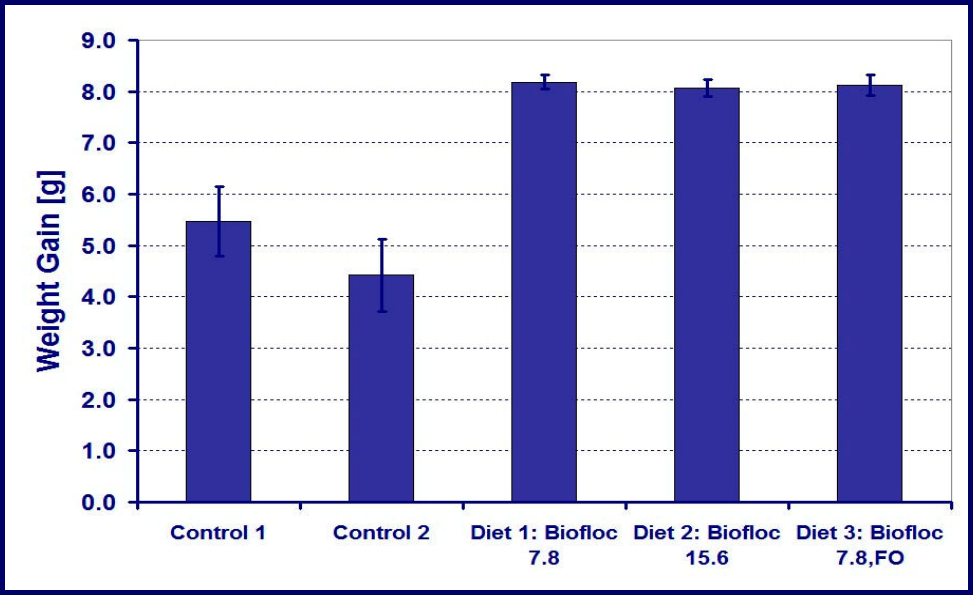
Shrimp Weight Gain



Microbial floc diets significantly ($P < 0.01$) outperformed control diets

FEED MANAGEMENT

Number of times per day

# of times/day	Growth (gm/wk)
1	1.1
4	1.7
14	2.2

CLEAR WATER SYSTEM, NO NATURAL PRODUCTIVITY (NP)

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Optimization of feed rate for higher production of *Litopenaeus vannamei* under super-intensive culture systems

S. Patnaik and A.L. Lawrence

Texas AgriLife Research Mariculture Laboratory,
Texas A&M System, 1300 Port Street, Port Aransas, Texas 78373

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Experimental Design (20 cm water depth)

Stocking shrimp /m³	Feed Rate (g/shrimp/wk)				Rep	Avg. Water Exch/d	
						%/tk	%/shrimp
658	1.0	1.5	2.0	2.5	5	787	2.75
1111	1.0	1.5	2.0	2.5	5	787	2.96
1620	1.0	1.5	2.0	2.5	5	787	3.10

Feed	
Feed Type	Zeigler 38.7% CP, 6.6% Fat, 3.0% Fiber, 10.6% Ash
Feed rate (assumed growth: 1.2 g/wk)	1.0, 1.5, 2.0, 2.5 g/shrimp/wk
Feed Frequency	3 times/day, manual

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Water quality vs. feed rates (min and max)

Stock /m³	Feed Rate g/sh/wk	TAN (mg/L)		NO_2-N (mg/L)		NO_3-N (mg/L)	
		Min	Max	Min	Max	Min	Max
658	1.0	0.147	0.715	0.003	0.011	0.018	0.088
658	1.5	0.223	0.999	0.004	0.018	0.012	0.084
658	2.0	0.174	1.012	0.004	0.024	0.011	0.086
658	2.5	0.303	1.453	0.004	0.052	0.009	0.086
1111	1.0	0.387	0.701	0.005	0.017	0.017	0.087
1111	1.5	0.106	1.577	0.005	0.061	0.013	0.085
1111	2.0	0.417	1.115	0.005	0.016	0.010	0.087
1111	2.5	0.471	1.092	0.005	0.015	0.010	0.087
1602	1.0	0.254	1.589	0.005	0.025	0.015	0.092
1602	1.5	0.286	2.144	0.005	0.010	0.012	0.088
1602	2.0	0.395	3.737	0.005	0.024	0.009	0.086
1602	2.5	0.801	3.289	0.006	0.023	0.005	0.080

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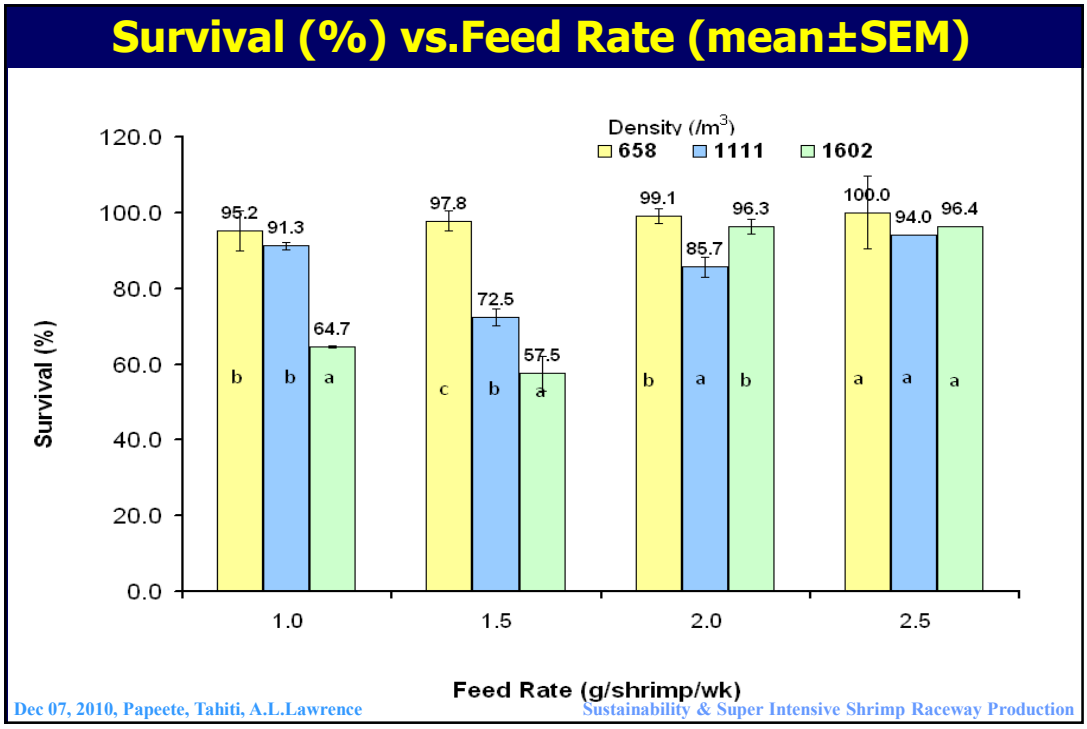
Survival (%) vs.Feed Rate (mean±SEM)
Density (/m3)
658
1111
1602
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Survival (%)
95.2
91.3
64.7
97.8
72.5
57.5
99.1
85.7
96.3
100.0
94.0
96.4
b
b
a
c
b
a
b
a
b
a
a
a
1.0
1.5
2.0
2.5
Feed Rate (g/shrimp/wk)
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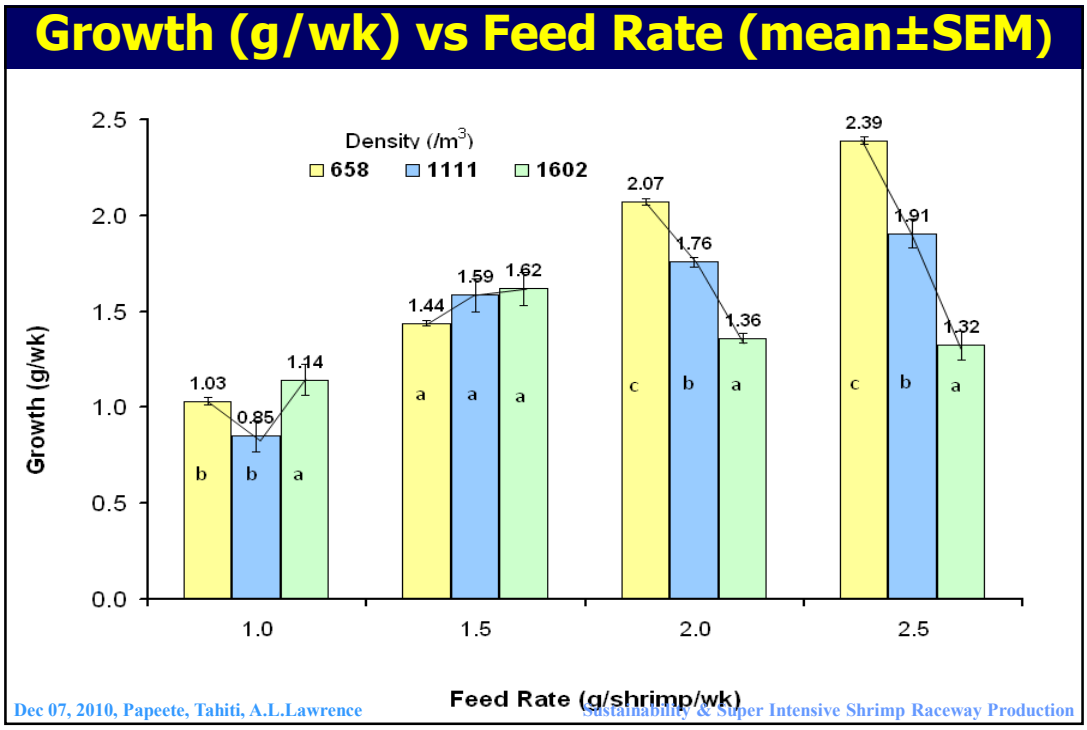
Growth (g/wk) vs Feed Rate (mean±SEM)
Density (/m3)
658
1111
1602
2.5
2.0
1.5
1.0
0.5
0.0
Growth (g/wk)
1.03
0.85
1.14
1.44
1.59
1.62
2.07
1.76
1.36
2.39
1.91
1.32
b
b
a
a
a
a
c
b
a
c
b
a
1.0
1.5
2.0
2.5
Feed Rate (g/shrimp/wk)
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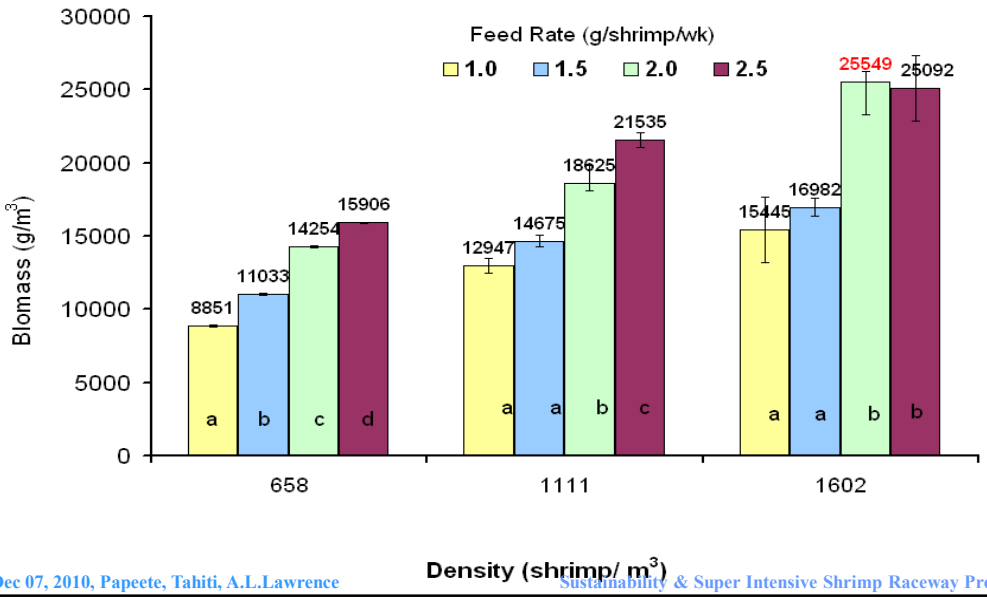
Biomass (g/m^3) vs Density (mean±SEM)



Shrimp Simulated Raceway Production

Shrimp /m^3	Gm feed/ smp/wk	Survival (%)	Final wt (g)	Gain	Growth (g/wk)	Biomass (g/m^3)	FCR
658	1.0	95.2	14.1	7.7	1.03	8850.6	1.28
658	1.5	97.8	17.1	10.7	1.44	11032.7	1.30
658	2.0	99.1	21.9	15.4	2.07	14254.1	1.17
658	2.5	100.0	24.4	17.7	2.39	15905.8	1.26
1111	1.0	91.3	12.8	6.3	0.85	12947.1	1.76
1111	1.5	72.5	18.2	11.8	1.59	14674.5	2.00
1111	2.0	85.7	19.5	13.1	1.76	18625.4	1.81
1111	2.5	94.0	20.6	14.2	1.91	21534.6	1.73
1602	1.0	64.7	15	8.5	1.14	15444.8	3.60
1602	1.5	57.6	18.5	12.0	1.62	16982.3	3.36
1602	2.0	96.3	16.8	10.1	1.36	25549.2	1.90
1602	2.5	96.9	16.3	9.7	1.31	25091.7	2.43

Alternative Management Strategy: Partial Harvesting

Important parameters for consideration:

- Growth Rate and Survival
- Percent harvested at time of Partial Harvest
- Size at time of Partial Harvest
- Number of Partial Harvests
- Selling price for sizes harvested at Partial Harvest and Final Harvest
- Maximum System Harvest Biomass

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Super-Intensive Shrimp Production Commercial Requirements for United States (actual level)

- Survival above 80%(up to 90%)
- Growth rate above 1.5(up to 2.4) gm/wk
- Production level above 20(up to 60) kg/m^2/year (200 metric tons/ha/year)
- Production of 20(up to 30) gm/shrimp with 30 gm/shrimp desired

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Super-Intensive Shrimp Raceway Production ----- ADVANTAGES

- Higher production levels /ha
- Higher growth rate & survival levels
- No disease problems, it is biosecure
- Predictable high internal rate of returns for typical sites
- Ideal for Partial Harvest

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Extrapolated Economic Data For Super Intensive Raceway System Using Stack Raceway System

Estimated Internal Rate of Return:

25 to 60%

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December 1, 2010, TAMU at Corpus Christi
What is Aquaculture-e.g. Shrimp, Super Intensive Raceway Production


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