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Thailand study: Performance trials generate important result

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Improving shrimp survival will be difficult

In collaboration with Oceanic Institute of Hawaii, USA, the vertically integrated shrimp producer Taksin Marine began conducting field evaluations in 2008 to assess the grow-out performance of selectively bred Pacific white shrimp (*Litopenaeus vannamei)* under commercial conditions in southern Thailand. Data collected by Oceanic Institute researchers from these evaluations have yielded valuable information about genetic parameters relevant to the operation of an effective family-based, selective-breeding program.

Shrimp were stocked in one round cage per pond.

Family production, evaluation

Two selected lines (Lines 1 and 2) and one domesticated, unselected line (Control Line) were produced at Oceanic Institute. For each selected line, one cohort of 14 families was produced each year. Representative shrimp weighing about 1.5 grams from each selected family and the Control Line were tagged for family/line identification and sent to the Taksin Marine farms for evaluation. To date, four field evaluations (F.E.) have been completed. Families from Line 1 were evaluated in FE1 and FE3 and families from Line 2 were evaluated in FE2 and FE4.

All shrimp used in the evaluations were stocked in round, 4.3-square-meter cages. One cage was installed per pond. Three cages were used in FE1, and four cages were used in FE2, FE3 and FE4.

About 450 tagged shrimp consisting of 30 shrimp/family and 30 control shrimp were stocked into each cage. Stocking density and feed management protocols were similar to those typically used at the Taksin Marine farms. Cages were harvested after 60 to 100 days, depending on growth and pond harvest schedules. At harvest, all surviving shrimp were identified by family and weighed individually.

Concurrent growout evaluations of siblings from selected families and the Control Line were conducted at Oceanic Institute in an indoor, recirculating raceway. Stocking densities, duration of grow-out and mean harvest weights for the evaluations ranged 295-410 shrimp per square meter, 69 to 95 days and 19.3 to 23.6 grams, respectively.

Genetic gain

Average daily growth for selected families in FE1 and FE2 was 0.214 and 0.212 grams, respectively (Table 1). After one generation of selection, daily growth increased to 0.244 grams in FE3 and FE4. Importantly, growth of selected lines improved relative to the Control Line, with gains of 4.7 and 4.1 percent observed for Lines 1 and 2, respectively. An increase in estimated mean breeding values for

each line showed similar genetic gains. Genetic gains for survival were not observed in these evaluations, as survival of the selected families and Control Line shrimp were similar in each field evaluation.

Moss, Mean family harvest weight and average daily growth, Table 1

	Selected Line Harvest Weight (g)	Selected Line Average Daily Growth (g)	Control Line Harvest Weight (g)	Control Line Average Daily Growth (g)	Control Line Difference In Growth (%)
Line 1					
FE2	22.3	0.214	17.4	0.163	30.7
FE4	16.4	0.244	12.2	0.180	35.4 (+ 4.7*)
Line 2					
FE1	17.9	0.212	11.7	0.152	39.6
FE3	20.2	0.244	14.5	0.170	43.7 (+ 4.1*)

Table 1. Mean family harvest weight and average daily growth for selected and control lines during four field evaluations in southern Thailand.

Correlations

Phenotypic correlations of family means for growth among cages within the field evaluations were highly positive (Table 2). In contrast, correlations for survival among cages typically fluctuated around zero with the exception of FE1. This was somewhat surprising, given that for each evaluation, cages were installed in ponds adjacent to or in close proximity to one another and stocked on the same day. The lack of significant positive correlations for survival among cages indicated that survival is an unstable trait and may be difficult to improve by selection.

Moss, Summary of phenotypic and genetic correlations, Table 2

Correlations	Growth	Survival	Growth/Survival
Cage/Cage			
FE1	0.81-0.82	0.70-0.85	–
FE2	0.85-0.92	0.04-0.25	–
FE3	0.78-0.95	-0.36-0.28	–
FE4	0.84-0.88	-0.44-0.26	
Trait/Trait at Taksin Marine			
FE1	–	–	0.07 (0.12)

FE2	–	–	0.35 (0.40)
FE3	–	–	0.28 (0.30)
FE4	–	–	0.25 (-0.40)

Table 2. Summary of phenotypic and genetic correlations for growth and survival. Genetic correlations are in parentheses.

In this study, growth and survival were poorly correlated with phenotypic and genetic correlations for individual field evaluations, ranging from 0.07 to 0.35 and -0.40 to 0.40, respectively. Likewise, the overall genetic correlation for all evaluations was essentially zero.

Phenotypic and genetic correlations for growth between shrimp families evaluated at Oceanic Institute and Taksin Marine were positive and typically moderate to high (0.08 to 0.81 and 0.32 to 0.70, respectively). These results indicated that selection for growth in one environment likely will result in positive gains in other environments, even when the environments are drastically different, as was the case in this study. Not surprisingly, phenotypic and genetic correlations for survival were low. However, all correlations were positive.

Implications for breeding programs

Results from these field evaluations indicated that shrimp growth can be improved after one generation of selection, even with a modest investment in selective breeding. However, improving shrimp survival likely will be more difficult.

Survival appears to be an unstable trait, even within an individual evaluation. This is problematic for breeding programs because measured survivals from field evaluations are likely not representative of general farm, area or regional survival. Furthermore, selection for growth will have little effect on survival, as these two traits appear to be poorly correlated.

There are concerns that selective-breeding programs that rear shrimp in benign environments such as specific pathogen-free breeding centers can promote traits that are maladaptive under commercial grow-out conditions. However, results from the field evaluations reported here did not support those concerns.

Moderate to high correlations for growth at Taksin Marine and Oceanic Institute suggested that selection for growth in one environment likely will result in positive gains in other environments. Thus, selection for growth at a genetic nucleus should improve growth performance at farm sites, although selection data from farm trials will be more useful if selection efforts are targeted for a specific location.

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