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Genetic improvement in Brazil

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Breeding efforts improve SPF white shrimp performance



Genetic gains were estimated through performance comparisons between selected and control families reared side by side in the same ponds.

Aquatec, the leading shrimp-breeding company in Brazil with about 20 percent of the market for Pacific white shrimp postlarvae, has maintained a pedigreed genetic improvement program since 1996. Within a classical full-sib family structure relying on elastomer tagging of animals at sizes of 2 to 3 grams for family identification, 60 full-sib families were initially produced every year.

Since 2003, under the umbrella of a multinational company involved in animal genetic improvement, six annual batches of 60 (*Penaeus vannamei*) families each were the result of increased breeding efforts focused on selection for growth and survival in commercial production environments.

New genetic improvement center

In 2006, Aquatec discontinued its association with its parent company and created a new company, Genearch Aquacultura, to concentrate on the genetic improvement of specific pathogen-free (SPF) *P. vannamei* lines recently imported from the United States, the first SPF lines in Brazil.

A new Genetic Improvement Center for preservation of the SPF status of these lines is near completion, and their genetic improvement program is starting. Four SPF lines with different shrimp production characteristics were imported, and the selection process has involved a combination of family and within-family selection.

Since 2003, the Aquatec genetic improvement program has been characterized by family sizes of 350 shrimp, 200 of which are tested in the Genetic Nucleus (G.N.) under strict biosecurity and 150 are tested in commercial ponds. Broodstock replacements come exclusively from the animals held in the nucleus. Grow-out performance tests have yielded average harvest weights of around 15 grams.

Family selection is based on a selection index comprising family genetic merit estimates for four traits: both growth and survival in the G.N. and pond environments. Within-family selection for growth is made exclusively in the G.N. environment. Inbreeding is controlled through the mating schemes and pedigree knowledge for the selected families.

Genetic gains

Commercial multiplication schemes rely on a narrow genetic base for both commercial product uniformity and genetic protection. Over a generation interval of 10 months, heritability estimates of about 0.36 for growth are achieved.

Genetic gains have been estimated through commercial performance comparisons between selected and control families reared side by side in the same ponds. Figs. 1 and 2 illustrate these comparisons as conducted for one batch. Results to date show annual harvest weight improvement of around 1.8 g and 0.13 grams per week growth rate gains.

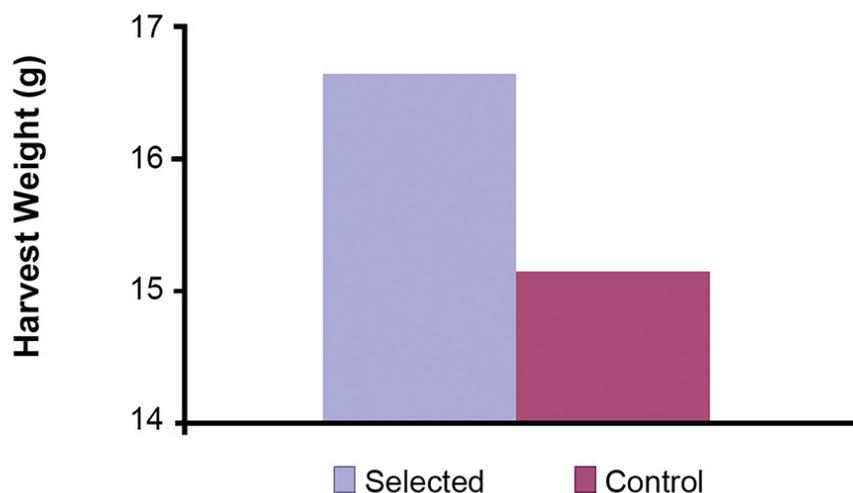


Fig. 1: Selection response for the harvest weight of one test batch in a commercial pond.

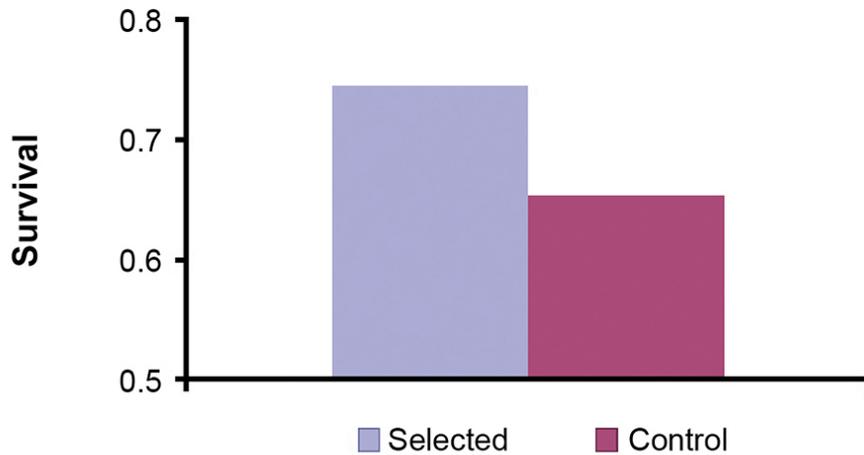


Fig. 2: Selection response for the survival of one test batch in a commercial pond.

The phenotypic trends also show positive tendencies. Figs. 3 and 4 illustrate the phenotypic trends of rising survival rates and improved weekly growth for the last four years/generations in field tests carried out in commercial production ponds.

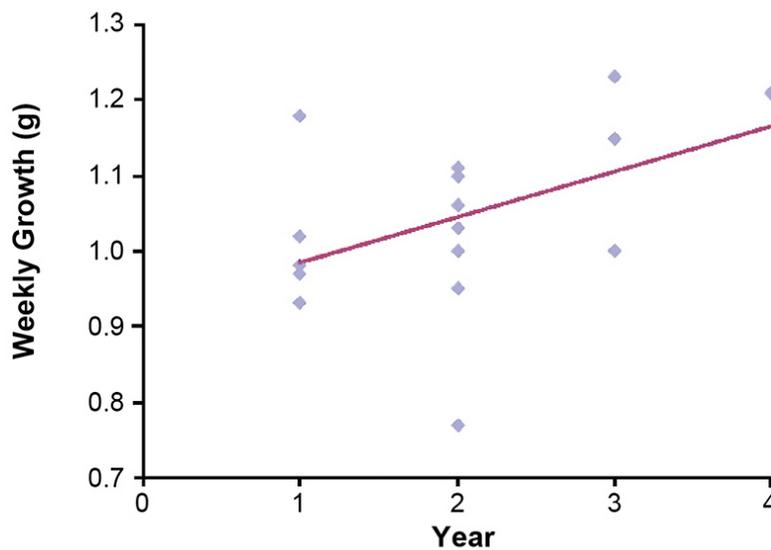


Fig. 3: Phenotypic trends for the weekly growth of selected shrimp.

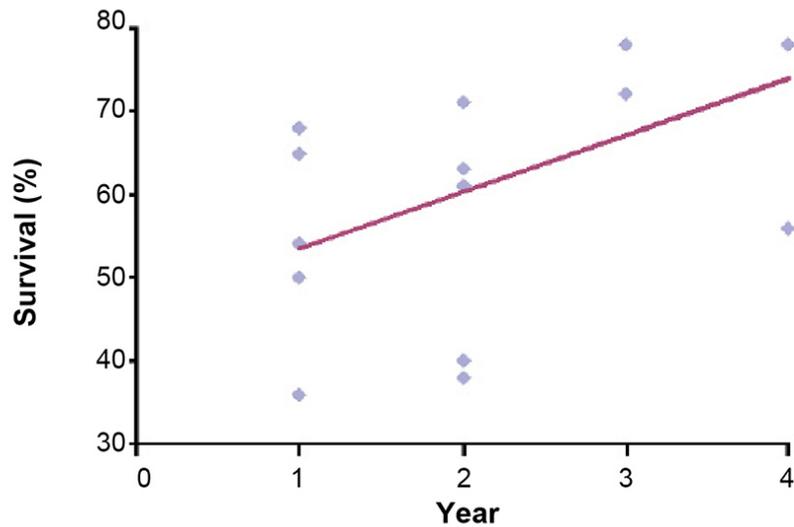


Fig. 4: Phenotypic trends for the survival of selected shrimp.

G x E interactions



The Genearch Aquacultura complex in Rio Grande do Norte, Brazil, is breeding SPF shrimp for improved production traits, benefiting from the experiences of Aquatec (above).

Concerns with genetic protection and commercial product uniformity led the authors to test hybrid shrimp improvement schemes following the hybrid corn model. The availability of three different founder populations in the program enabled the conducting of several diallel experiments and quantification of heterosis levels for different shrimp production traits.

Heterosis levels for shrimp survival and biomass production were typically in the 20 to 30 percent range. But strong G x E interactions for survival, sampling genetic effects, and low accuracy for the founder line estimates for cross-bred merit meant that in reality, batches would have to be composed of many more families if any reciprocal recurrent selection scheme were to be successful in the context of a commercial shrimp-breeding program. The limitations imposed by elastomer tagging precluded this possibility.

G x E interactions were found to be strong for survival, with phenotypic correlations of family means usually in the -0.1 to +0.2 range between the G.N. and commercial pond performance tests. Although G x E interactions for growth were less pronounced, phenotypic correlations of family means between the G.N. and pond environments seldom were higher than +0.5.

New pathology lab

A new Shrimp Pathology Laboratory is also being established by Genearch Aquacultura in Brazil. This laboratory will soon have the functional capacities to conduct the formal disease challenge tests that will enable the company to add specific pathogen-resistant (SPR) attributes to the imported SPF lines.

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