Heritability Of Survival From 70 to 130 Days Post-Hatching In The Pacific White Shrimp (*Penaeus (Litopenaeus) vannamei*) Using Generalized Mixed Models

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Introduction

Worldwide shrimp production from aquaculture systems has increased importantly during the last decade. In Mexico it contributed to more than 60 percent of the national production in 2008 of 125,350 Metric Tons (FAOSTAT, 2009). The Pacific white shrimp (*Penaeus (Litopenaeus) vannamei*) is the main shrimp species cultured in Mexico. Profitability in the shrimp industry depends on growth and survival. Similar to other aquaculture species, economic importance of survival and growth in *P. vannamei* are high (Ponzoni, 2008). Therefore, estimation of genetic parameters for these traits is a priority. Heritability for growth (body weight at harvest) in Mexico has been estimated (Castillo-Juárez et al., 2007; Campos-Montes et al., 2009) but estimates for survival in *P. vannamei* are very scarce and have been estimated using only linear models (Gitterle et al., 2005; Trani-Herrera, 2007).

The aim of this study was to estimate the heritability of survival in a Mexican commercial hatchery facility, using data from a selected population and generalized linear models.

Material and methods

Data. Multi-generation pedigreed data for survival individual shrimp from 70-130 days post-hatching were obtained from a commercial hatchery (Maricultura del Pacífico SA de CV). Data included information from five generations of the breeding program (years 2005-2009), where 150 families are grown every year in three ponds (environments) located in two places of northwest of Mexico per year with densities varying from 10 to 180 shrimp/m^2. Average survival ranged from 47.5 to 80.5% across location-density-years. Pedigree included animals that were hatched from 2002 to 2009. The family structure is shown in Table 1.

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Model. A logistic mixed model and ASReml (Gilmour et al., 2009; Southey et al., 2003) were used to estimate survival heritability. The model included the fixed effect of year-location-density, and animal, full-sib common environment, and residual as random effects.

Table 1. Family structure per year

Year	Number of Sires	Average Number of Dams per Sire
2005	82	1.32
2006	100	1.48
2007	107	1.40
2008	113	1.32
2009	110	1.35

Results and discussion

Table 2 shows the variance components estimates and the heritability estimate for survival. The heritability estimate was 0.06 ± 0.01. This estimate was similar to that found by Trani et al. (2007) who estimated it as 0.07 ± 0.02 using data from the same population from generations 2004-2005 and a linear animal model. This heritability is also in agreement with Gitterle et al. (2005) findings who estimated it ranging from 0.04 to 0.10 in a Colombian hatchery using a linear animal model too.

Table 2. Variance components and heritability for survival

Variance Source	Estimate
Animal	0.21
Full-sib Family	0.10
Residual Variance	3.29
Phenotypic Variance	3.60
Heritability	0.06 ± 0.01

Conclusion

Based on the heritability estimate for survival, and given its economic importance for the shrimp industry, this trait can be included in the breeding programs. Nevertheless, the optimal inclusion of survival will depend on its relative economic value and its association with growth traits. Research in this area of study is needed. Also research to study genotype by environmental effects on survival is required to confirm that the same genetic effects are affecting this trait across time and space.

Although this trait can be genetically improved, it is worth to note that farmers should improve management practices to provide better environments and sanitary conditions to improve survival in their commercial ponds.

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