GENETIC GROWTH IMPROVEMENT OF PERCA FLUVIATILIS: A REVIEW

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Introduction. Among the different problems related to Eurasian perch aquaculture, the poor growth rate can be considered as a major limiting factor for the emergence of a commercial activity (Mélard et al., 1996). The production of marketable 80-100 g fish (Swiss market) reared under optimum conditions at a temperature of 23°C in recirculating aquaculture system (R.A.S.) takes at least one year starting from larvae (Figure 1). Under natural temperature regime (cage rearing), the minimal market size is obtained in more than 800 days (Kestemont and Mélard, 2000). Resulting from this poor growth capacity, food conversion ratio (FCR) using high quality diet ranges from 1.0 for 1 to 40 g fish but increases to 1.5 then 2.0 for 80 and 300 g fish, respectively (Mélard et al. 1996).

Due to the slow growth, intensive perch culture is impaired by low production rate (350-400 g m⁻² d⁻¹), even at high stocking biomass (60-80 kg m⁻³). High FCR also contribute to reduce the productivity of perch rearing. Together these 2 factors result in high production costs, especially in recirculating aquaculture system and, consequently, low profitability. The emergence of a new market in Belgium, France and Germany for larger fish (350-400 g) also strengthens the necessity to improve growth characteristics of Eurasian perch.

![Figure 1. Growth curves of Eurasian perch (Belgian strain; mixed sex populations) reared under intensive conditions at 23°C in R.A.S. and in cage under natural temperature.](image1)

Growth rate heterogeneity is another major feature of perch rearing (Figure 2). Fast growing fish (group 3, figure 2) growth twice as fast than slow growing ones (group 1, Figure 2). The high growth rate of some fish, likely having a genetic component, suggest that the possibility to increase growth of Eurasian perch using selective breeding programs exists. Several techniques based on genetic characteristics including strain selection, domestication, all-female populations and hybridisation have been developed to improve growth rate of Eurasian perch in culture conditions.

![Figure 2. Growth heterogeneity of an Eurasian perch family reared under intensive conditions in R.A.S during 200 days at 23°C.](image2)

Strain selection. Research conducted on growth of several Eurasian perch wild strains originating from different regions of Europe reared in R.A.S at 23°C suggested marked differences between strains: at day 200 starting from larvae, body weights of Belgian and North-East France strains were 56% and 76% larger respectively than in South-West France and North Italy ones (Figure 3). Starting from 4.5 g fingerlings, survival was also higher (60%) in Belgian and North-East France strains than in South-West France and North Italy ones (Mandiki et al., 2003).

![Figure 3. Growth (mean of duplicate) of 4 different strains of Eurasian perch reared under intensive conditions in R.A.S. at 23°C, two progenies / strain.](image3)

Domestication. It is well established that domestication is beneficial when fitness is positively correlated with desired aquacultural traits like growth rate or eggs and larvae quality. The comparison of growth potential of domesticated progenies (F1 & F2) from captive breeders (no selective breeding program) to wild progenies obtained from wild breeders from the same strain (Belgium, river Meuse)
reared in R.A.S. at 23°C showed a significant growth rate improvement in domesticated fish. At 300 day old, F1 and F2 domesticated fish growth 33% and 72% faster, respectively, than wild fish (Figure 4).

![Figure 4. Effect of domestication on growth of Eurasian perch reared in R.A.S at 23°C (Belgian strain; mean of duplicate).](image)

**All-female populations.** Due to the inhibition of sexual maturation under a constant temperature of 23°C (GSI>20% in natural temperature condition) and the higher intrinsic growth potential, females grow faster than males in intensive conditions. At 400 and 600 days old, growth rates of females are 20% and 80% higher respectively than males. Due to this faster growth rate of females vs males, rearing of all-female populations results in an increase of 35% of growth for marketable fish: the market size of 100 g is obtained in 9 vs 12 months in mixed sex populations (Figure 5). All-female populations can be obtained using sex reversed males breeders (male phenotype, XX genotype; Rougeot et al., 2002).

![Figure 5. Comparative growth of mixed sex and all-female batches of Eurasian perch reared in R.A.S. at 23°C (Belgian strain; mean of duplicate).](image)

**Hybridisation.** Due to heterosis, hybrids of *P. fluviatilis* female x *P. fluvescens* male obtained by artificial fertilisation display an increase of growth performances when compared to purebred *P. fluviatilis*: fish reach a market size of 100 g in 11 months vs 12 months for Eurasian perch (Figure 6, growth rate 42% higher on day 800). The survival rate of hybrids is also 67% higher on day 800.

![Figure 6. Comparative growth of purebred *P. fluviatilis* and hybrids *P. fluviatilis* female x *P. fluvescens* male reared in R.A.S at 23°C (mean of duplicate).](image)

**Conclusion.** The 4 factors mentioned above, alone or in combination, can induce a positive response in the short-term, to enhance the growth of Eurasian perch. An improved growth rate combined with lower FCR should significantly contribute to an increase of productivity and a lowering of production costs of Eurasian perch in intensive culture. Supplementary information is needed about the effects of these 4 factors on growth. A probable family effect on growth should also be evaluated. The identification of the best strain adapted for intensive culture conditions is the first step to start a selection program. In the long run, selective breeding program exploiting the genetic part (additive genetic variance) of the high growth heterogeneity of perch (figure 2) should result in domesticated strains showing higher growth rate. To initiate a directional selection program it will be necessary firstly to establish the heritability of this quantitative trait in Eurasian perch.

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**References.**