



Provided that broodstock purity is maintained, YY male technology can be applied in existing hatchery systems without special facilities or labor requirements.

Potential Of YY Tilapia Male Technology

Summary:

Since male tilapia grow faster and larger than females, all-male populations are preferable in aquaculture of the species. Single-sex culture also alleviates early sexual maturation and uncontrolled reproduction. YY male technology based on the genetic manipulation of sex provides a robust, reliable method of achieving male fish. It avoids the use of hormones and maintains strain purity in genetically normal males. Provided broodstock purity is maintained, YY technology can be applied at hatcheries without special facilities or labor requirements.

The most successful sex-reversal and breeding program with the greatest economic impact in tilapia farming has been the production of all-male XY populations of Nile tilapia from YY males. In 2001, biologist Dr. Graham Mair concluded that YY male technology provides a robust and reliable solution to the serious and widespread problems of early sexual maturation, unwanted reproduction and overpopulation in tilapia culture.

In countries like Mexico and Ghana, mixed-sex tilapia populations are employed mainly in some fisheries restocking programs and small-scale, basic aquaculture operations. Monosex all-male tilapia progeny grow faster and to larger sizes than females.

To date, the establishment of all-male tilapia has been achieved through manual sexing, hybridization, hormonal sex reversal or YY male tilapia technology. All these technologies have advantages and disadvantages in their application, and only hormonal sex reversal has become widely used worldwide

Natural YY Male Tilapia

The YY male tilapia technology is based on the genetic manipulation of sex. This is achieved through a combination of feminization and progeny testing to identify the novel YY genotype (Figure 1) that sires only XY natural male progeny (Figure 2) or natural male tilapia. However, the occurrence of occasional

Dr. Adrian G. Hartley-Alcocer

Sustainable Aquaculture
P/O Bong 20
5941NL Velden, The Netherlands
a.g.hartley@sustainable-aquaculture.com

Dr. Eric N. Bink, M.S.
Til-Aqua International Ltd.
Someren, The Netherlands

females/males can occur from the action of several autosomal sex-modifying genes. Feminization of the YY genotype is a vital step in the development of the YY technology on a large scale, as it makes possible the production of YY males without the need for time-consuming progeny testing.

Feminization (XY females) can be achieved through gynogenesis by irradiation and hormonal sex reversal or thermal treatment. However, although not always feasible with all strains of tilapia, sex reversal thermal treatment has proven to be a more desirable method to produce XY females in large-scale operations, as it avoids the employment of hormones at any stage of the production process.

This is especially important when producing tilapia in countries where the use of hormones is prohibited in the production of food products. Also important is the increasing interest of major markets for sustainable and environmentally friendly food sources.

Progeny testing XY females with normal XY males should spawn 75% males (25% YY and 50% XY), and 25% XX females result from the XY-XY mating. Male progeny from this mating are then grown for a second generation for progeny testing. When the YY males are test crossed with normal XX females, 100% XY male progeny result.

YY Technology Benefits

In 1997, Mair and fellow researchers described the important comparative advantages and disadvantages of the YY male tech-

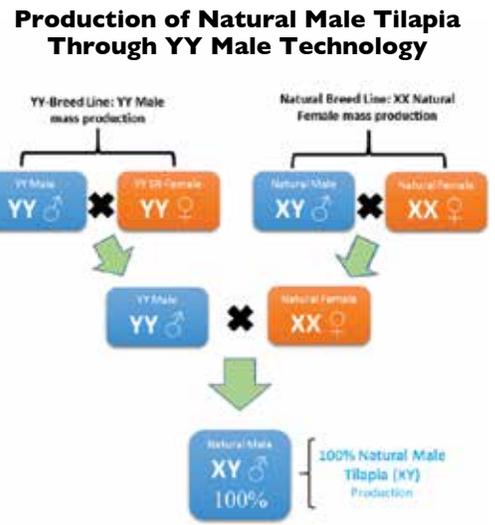
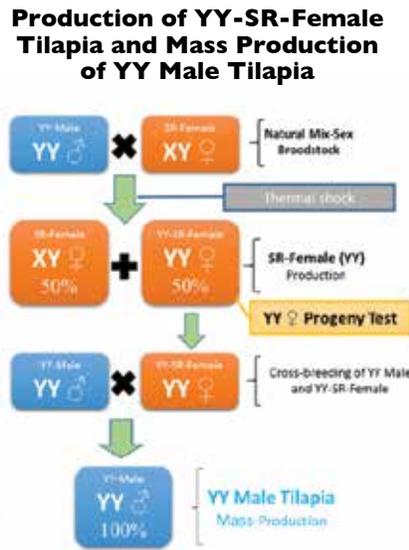
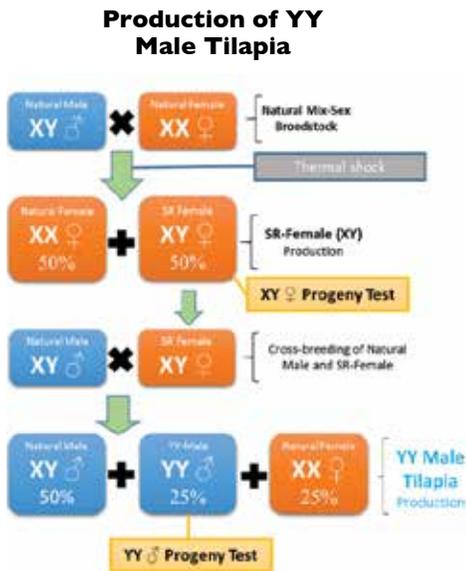


Figure 1. Schematic production of YY male tilapia and mass production through YY SR female tilapia.

Figure 2. Schematic production of natural male tilapia sired by YY male tilapia.

nology as a means for mass production of monosex male tilapia, as compared to other commonly used alternatives such as manual sexing, hybridization and sex reversal. One of the biggest advantages of using the YY technology is that its masculinization effect always works. Another advantage is that these all-male populations consist of completely normal XY males.

The technology is safer for farm operators because it avoids the health risks associated with the use and handling of hormones. Hormones can be harmful to humans if swallowed or absorbed through skin and/or inhalation, and have a danger of cumulative effects. The commonly used hormone methyltestosterone (M.T.) is considered carcinogenic and can cause liver damage or interfere with normal reproductive functions in humans and animals.

YY male technology is safer for fish and results in greater fingerling survival rates, as it avoids the health risks associated with hormone usage. Work in 2011 by Dr. Miguel Rubio Godoy and co-workers and 2001 research by Gina Conroy described the neg-

ative impacts of M.T. treatment in fingerling survival rates due to higher levels of ectoparasitic, fungal and bacterial infestations as a result of the suppression effect on the fish immune systems.

The use of YY technology prevents many environmental impact risks that hormone residues in the production water, units and system waste could have. It also reduces ecological impacts on wild populations when farmed stocks are released through restocking programs and/or accidental escapes.

The release of hormone sex-reversed tilapia in the wild consists of 50% males with XX chromosomes. The next generation in the ecosystem will have a very high female ratio. The natural balance of sexes in the ecosystem will change dramatically, a situation the local fisherman will dislike, as they will catch only very small fish. This problem is worldwide. For example, Mexico invests millions of dollars in restocking programs with hormone sex-reversed tilapia (males with double X chromosomes). Large escapes from culture in places like Lake Volta in Ghana can change the sexual balance of natural tilapia populations.

Canadian organic red Nile tilapia fry and fingerlings

- All male, GMO, hormone and disease free
- Partner with Til-Aqua Int'l -The Netherlands
- Pure strain, NMT™, fast growth rates
- High yields from enhanced survival
- Better food conversion ratios and greater size uniformity
- Shipping available worldwide year round
- Health certificate provided and full traceability

www.noafisheries.com

Call: 416-546-6623
info@noafisheries.com

Best Aquaculture Practices Auditor Course



This course will cover the BAP seafood-processing plant standards, finfish and crustacean farm standards, shrimp hatchery standards, salmon standards, mussel standards and feed mill standards. New auditor candidates, returning auditors and observers are welcome. Please check the BAP website for competency requirements, course schedule, fees and further details.

Registration deadline: May 23.

Phone: +1-352-563-0565

Web: www.bestaquaculturepractices.org

Compared to M.T. treatment, it is a more consistent and reliable technique that achieves over 95% male offspring, while it is not rare to see male ratios below 90% for hormonal treatment. The YY approach promotes offspring heterosis or hybrid vigor, as the technique requires keeping two different lines between the male (YY) and female (XX) broodstock.

Finally, increased interest by major markets worldwide – particularly in Europe and recently in the United States – for environmentally friendly and sustainable food sources. The application of hormones to fish destined for human consumption is prohibited in the European Union under a formal European Commission directive, which also prohibits the importation of animal products produced with hormones.

Perspectives

The YY male technology provides a robust and reliable solution to the problem of early sexual maturation, unwanted reproduction and overpopulation in tilapia culture, and can increase production of tilapia by 50%.

The technique can be considered environmentally friendly, as no hormones are applied to fish at any stage of the production process. Species and strain purity are maintained, and the fish produced for culture are normal genetic males. Although the development process is time-consuming and labor-intensive, once developed, the production of monosex males can be maintained through occasional feminization of YY genotypes.

Provided that broodstock purity is maintained, YY male technology can be applied in existing hatchery systems without special facilities or labor requirements. Discounting the initial development costs, additional costs for application of this technology at the hatchery level are minimal, while the potential economic advantages to growers can be considerable.



a xylem brand



Do your fish need a babysitter?

Give them the best around-the-clock care with a YSI aquaculture water quality system monitor and optional AquaManager software or Aqua-Viewer App. Simple enough to monitor one tank, powerful enough to care for a farm-load of your most precious babies.



5200A
Multiparameter
ysi.com/5200A

5500D
MultiDO (optical)
ysi.com/5500D



YSI.com/aquaculture
800 765 4974 (US) • +1 937 767 7241

YSI Incorporated is a brand of Xylem, whose 12,500 employees are addressing the most complex issues in the global water market. ©2013 Xylem Inc.

xylem
Let's Solve Water