Indian J. Fish., 59(2) : 171-174, 2012

Note

Lower size at maturation reduces somatic yield in pond reared stunted yearlings of rohu *Labeo rohita* (Hamilton)

R. CHARAN, P. P. SURESH BABU, S. S. H. RAZVI, G. VENUGOPAL, AND A. ANURAJ

Kakinada Centre of Central Institute of Fisheries Education, Kakinada - 533 007, Andhra Pradesh, India
e-mail: sbabu78@yahoo.com

ABSTRACT

Presently in Andhra Pradesh majority of the carp farmers use stunted yearlings as the stocking material owing to their better performance in terms of growth, survival, disease resistance and the ease of availability throughout the year. But many of the farmers reported the problem of maturation at smaller size leading to reduced growth performance of stunted fishes. In the present study, variation in the gonado-somatic index (GSI) and final somatic yield of stunted rohu females has been compared with that of normal female brooders and stunted males. The GSI of stunted females was almost 1.6 times higher than normal females and the somatic yield was significantly lower ($p< 0.05$).

Keywords: Gonado-somatic index, *Labeo rohita*, Rohu, Stunted yearling

India is renowned as the 'carp country' and Indian major carps (IMC) form the mainstay of culture fishery sector here. This sector contributes as much as 87% of the total national aquaculture production. IMCs contributed to the total aquaculture production of India to the tune of 2.8 million metric t during the year 2008 (FAO, 2008). Among Indian major carps, rohu is the most preferred fish, mainly due to its higher consumer preference and growth rate. It occupies 13th position among the cultured species of aquatic organisms in the world (FAO, 2005).

Since carps are known to grow faster during their second year, now a days ponds are stocked with 8-12 month-old stunted fishes of 100 -150 g, instead of fry or fingerlings as practised in the traditional system. Stunted yearlings are better stocking material for carp culture because of their higher survival rate. They are less vulnerable to predation and diseases and are more tolerant to environmental fluctuations; require less time to reach marketable size leading to higher production. Stunted yearlings have higher demand as they utilise seasonal grow-out ponds efficiently and the fishes can be sold at a higher price too (Radheysham and Saha, 2009).

Even though stunted yearlings have several advantages, many farmers reported the problem of maturation at a smaller size. Since they are more than one year old, probability of getting matured fish during the culture period is more. Early maturation is a major problem in many farmed fish species due to the negative impact on growth performance, flesh composition, external appearance, behaviour and health (Taranger *et al.,* 2010). Early attainment of maturity results in diverting the energy for somatic growth towards gonad development, production of gametes and reproductive behaviours leading to considerable reduction in growth and thus affecting the economics of farming (Bhujel *et al.,* 2007). In addition, many of the previous reports indicate that the weight loss due to reproductive growth results in longer time to reach harvestable size (Kadri, *et al.,* 1996; Hendry and Beall, 2004; Taranger *et al.*, 2010). Hence, the total amount of feed needed to reach a certain body size will increase if the fish is allowed to go through one or more spawning periods before harvest and thereby negatively affect the sustainability of fish farming in terms of feed utilisation (Stead *et al.,* 1999). Early maturation especially for the undersized fishes also reported to have negative impact on the immune system of the fishes (Maule, *et al.,* 1996; Suzuki, *et al.,* 1997; Hou, *et al.,* 1999). Maturation at a smaller size can also lead to health problems in farmed fishes due to compromised health, spawning failure and damages caused by aggressive behaviour (Harris and Bird, 2000; Law *et al.,* 2001).

In the present study, impact of maturation at smaller sizes on the performance of stunted yearlings of rohu in culture ponds was evaluated, especially during the maturation phase. For this, stunted yearlings of rohu (*Labeo rohita*) were procured from the Kaleru Fishermen Co-operative Society, East Godavari District, Andhra Pradesh,

where the fingerlings (average size 50 mm) were stocked at 5 per m^2 in a 3 ha tank and reared for 12 months without providing any supplementary diet but with manuring using cow dung at 2t ha^{-1} once in a month. The stunting was done from November 2008 to October 2009. The experimental rearing was conducted at the Freshwater Fish Farm (FWFF) of Kakinada Centre of Central Institute of Fisheries Education (CIFE) at Balabhadrapuram, East Godavari District, Andhra Pradesh. Fishes were grown in three earthen ponds of 200 m^2 area. Ponds were limed (at 100 kg ha^{-1}) and fertilized (single super phosphate at 50 kg ha^{-1}) and the fishes (average weight 96 ± 1.82 g) were stocked at the rate of 100 numbers per pond in November 2009. Fishes were fed with carp floating pellets (UNO feed company Pvt. Ltd. Bhimavaram, Andhra Pradesh) containing 28% of protein twice a day at 4% body weight throughout the culture period.

Growth sampling (15 numbers per pond) was done at fortnightly intervals using a dragnet to record the length and weight of individual fishes. Total weight of fish was measured using a plate balance with an accuracy of 2 g. Mean value of weight was calculated to assess the specific growth rate (SGR) according to De Silva and Anderson (1995).

Sexual differentiation of the fishes was done according to the secondary sexual characters given by Jhingran and Pullin (1985). Gonads were collected fortnightly, from 10 fishes each from different ponds during the maturing season (May and June). The total weight of the fishes and the gonad weights were noted to calculate gonado-somatic index (GSI). GSI was calculated by dividing the gonad weight with the total weight of fish and multiplying with hundred. In order to find out the somatic yield, the following formula was used:

$$\text{Somatic yield} = \frac{\text{Weight of fish} - \text{Weight of gonad}}{\text{Weight of fish}}$$

In order to compare the GSI, somatic yield and average body weight of the stunted fishes with the professional brooders, mature brooder fishes (3 years age group) were collected from the brood stock ponds of Freshwater Fish Farm (FWFF) of CIFE Kakinada Centre, Balabhadrapuram.

The stunted fishes showed distinct male and female characters from April onwards and the measurement of GSI was done from 1st May to 15th June 2010. Sena *et al.* (2002) reported that the onset of maturation in rohu begins during April - May in confined conditions. GSI was used as one of the important indices to compare the maturity of fishes (Afonso *et al.,* 1999; Lee *et al.,* 2002; Bhandari *et al.,* 2004). In the present study, the difference in GSI of males and females shows a clear indication of progression of gonad development in both males and females during this season (Table 1). GSI of females was found to be 10 times higher than that of males during the breeding season and this result is in agreement with the report of Khan *et al.* (2005). Fig. 1 and 2 represent the extent of gonad development in stunted males and females even when the fish are smaller in size. The difference in average body weight, average weight of gonad, somatic yield and GSI of stunted males, stunted females and normal brooders are given in Table 2. Significant variation in average weight of gonad, somatic yield and GSI of males (stunted), females (stunted) and normal females were observed ($p< 0.05$). Female stunted yearlings of rohu yielded less flesh compared to normal brooders and stunted males as indicated by the somatic yield values owing to the presence of larger gonads. Early maturation is a major problem in many farmed fish species (Taranger *et al.,* 2010) and attainment of maturity results in diverting the energy from somatic growth to gonad development affecting the economics of farming (Naesje *et al.,* 1988; Jarvi, 1990; Hendry and Beall, 2004; Bhujel *et al.,* 2007). In addition, the weight loss due to reproductive growth necessitates longer duration to reach harvestable size leading to increased feed requirement (Stead, *et al.,* 1999).

Table1. Difference in GSI of males and females of rohu during the culture period

Sex	Days of culture			
	1st May	15th May	1st June	5th June
Females	1.9±0.95	13.35 ± 0.85	21.15 ± 1.05	21.2 ± 1.1
Males	0.24 ± 0.02	1.105 ± 0.015	1.84 ± 0.05	1.98 ± 0.14

Table 2. Difference in average body weight, average weight of gonad, somatic yield and GSI of stunted males (mean±SD), stunted females and normal females of *R. rohita*

Fish	Average weight (g)	Average weight of gonad (g)	Somatic yield per kg	GSI
Males (stunted)	601±2.33	11.7±0.99	1 : 0.98	1.93±0.02
Females (stunted)	625±8.6	133±3.03	1 : 0.74	21.3±0.28
Normal females	1333±333.6	183.3±60.1	1 : 0.86	13.3±1.15

In nut shell, the results of the present study indicates that the gonad development in stunted females during the culture period may affect the somatic growth and thereby the somatic yield in female fishes. These results indicate the need for arresting the gonad development of stunted females of Indian major carps during the culture period. Hormonal or genetic interventions can be adopted to

Fig. 1. Ovary of maturing stunted female rohu

Fig. 2. Testis of maturing stunted male rohu

minimise this problem in order to achieve maximum somatic growth and economic returns from carp farming.

Acknowledgments

The authors are extremely grateful to The Director, Central Institute of Fisheries Education, Mumbai for the continuous encouragement to pursue this research work.

References

Afonso, L. O. B., Iwama, G. K., Smith, J. and Donaldson, E. M. 1999. Effects of the aromatase inhibitors fadrozole on plasma sex steroid secretion and ovulation rate in female Coho salmon, *Oncorhynchus kisutch* close to final maturation *Gen. Comp. Endocrinol.,* 113: 221-229.

Afzal Khan, M. Jafrii, A. K. and Chadha, N. K. 2005. Effects of varying dietary protein levels on growth, reproductive performance, body and egg composition of rohu, *Labeo rohita* (Hamilton), *Aquacult. Nutr.,* 11; 11–17.

Bhandari, R. K., Higa, M., Nakamura, S. and Nakamura, M. 2004. Aromatase induces complete sex change in a protogynous honeycomb grouper, *Ephinephelus merra. Mol. Reprod. Dev*., 67: 303-307.

Bhujel, R. C., Little, D. C. and Hossain, A. 2007. Reproductive performance and the growth of pre-stunted and normal Nile tilapia (*Oreochromis niloticus*) broodfish at varying feeding rates. *Aquaculture*, 273: 71-79.

De Silva, S. S. and Anderson, T. A. 1995. *Fish nutrition in aquaculture*. Chapman and Hall, London. 319 pp.

FAO 2005. *Yearbook on Fishery Statistics*. FAO, Rome, Italy.

FAO 2008. *Yearbook on fishery statistics*. FAO, Rome, Italy.

Harris, J. and Bird, D. J. 2000. Modulation of the fish immune system by hormones. *Vet. Immunol. Immunopathol.,* 77: 163-176.

Hendry, A. P. and Beall, E. 2004. Energy use in spawning Atlantic salmon. *Ecol. Freshwat. Fish*, 13: 185-196.

Hou, Y., Suzuki, Y. and Aida, K. 1999. Changes in immunoglobulin producing cells in response to gonadal maturation in rainbow trout. *Fish. Sci.,* 65: 844-849.

Jarvi, T., 1990. The effect of male dominance, secondary sexual characteristics and female mate choice on the mating success of male Atlantic salmon, *Salmo salar. Ethology,* 84: 123-132.

Jhingran, V. G. and Pullin, R. S. V. 1985. *A hatchery manual for the common Chinese and Indian major carps*. Asian Development Bank and International Center for Living Aquatic Resources Management, 191pp.

Kadri, S., Mitchell, D. F., Metcalfe, N. B., Hunting Ford, F. A. and Thorpe, J. E. 1996. Diffferential patterns of feeding and resource accumulation in maturing and immature Atlantic salmon, *Salmo salar. Aquaculture,* 142: 245-257.

Law, W. Y., Chen, W. H., Song, Y. L., Dufour, S. and Chang, C. F. 2001. Differential *in vitro* suppressive effects of the steroids on leukocyte phagocytosis in two teleosts, tilapia and common carp. *Gen. Comp. Endocrinol*., 121: 163-172.

Lee, Y. H., Yueh, W. S., Du, J. L., Sun, L. T. and Chang, C .F. 2002. Aromatase inhibitors block natural sex change and induce male function in the protandrous black porgy, *Acanthopagrus schlegeli* Bleeker: possible mechanism of natural sex change. *Biol. Reprod.,* 66: 1749-1754.

Maule, A. G., Schrock, R., Slater, C., Fitzpatrick, M. S. and Schreck, C. B. 1996. Immune and endocrine responses of adult chinook salmon during freshwater immigration and sexual maturation. *Fish Shellfish Immunol.,* 6: 221-233.

Naesje, T. F., Hansen, L. P. and Jarvi, T. 1988. Sexual dimorphism in the adipose fin of Atlantic salmon *Salmo salar* L. *J. Fish Biol.,* 33: 955-956.

Radheysham, De, H. K. and Saha, G. S. 2009. Role of community in production of larger and quality fingerlings. *Aquacult. Asia Mag.*, 14:16-17.

Sena, U., Mukherjee, D., Bhattacharyya, S. P. and Mukherjee, D. 2002. Seasonal changes in plasma steroid levels in Indian major carp *Labeo rohita*: influence of homologous pituitary

extract on steroid production and development of oocyte maturational competence. *Gen Comp. Endocrinol.*, 128: 123-134.

Stead, S. M., Houlihan, D. F., Mclay, H. A. and Johnstone, R. 1999. Food consumption and growth in maturing Atlantic salmon (*Salmo salar*). *Can. J. Fish. Aquat. Sci.,* 56**:** 2019-2028.

Suzuki, Y., Otaka, T., Sato, S., Hou, Y. Y. and Aida, K. 1997. Reproduction related to immunoglobulin changes in rainbow trout. *Fish Physiol. Biochem.,* 17: 415-421.

Taranger, G. L., Carrillo, M., Schulz, R. W., Fontaine, P., Zanuy, S., Felip, A., Weltzien, F. A., Dufour, S., Karlsen, O., Norberg, B., Andersson, E. and Hansen, T. 2010. Control of puberty in farmed fish. *Gen. Comp. Endocrinol*., 165: 483-515.

Date of Receipt : 27.10.2011
Date of Acceptance : 24.03.2012