Tiger Barb (Puntiustetrazona) Spawning Using Different Substrates

Rumondang*, Suhardi Indra Fansyah, Juliwati P Batubara and Khairani Laila
Study Program of Aquaculture, University of Asahan, Kisaran North Sumatera Indonesia.

* rumondang1802@gmail.com

Abstract. Availability of quality and effective tiger barb seeds is highly limited and leads to unfulfilled market demand. This study was conducted from April - May 2018 in the Laboratory of Aquaculture, Faculty of Agriculture, University of Asahan. Result of analysis of variance (ANOVA) shows that Fstatistic>Ftable (636,097>0,17), thus H0 is rejected and H1 is accepted, hence treatment of different substrates significantly affected egg number of tiger barb. Similarly, the value of fecundity, hatching rate, and survival rate obtained in this study resulted in Fstatistic>Ftable (353.676>0,17) or H0 is rejected and H1 is accepted, hence significant effect on hatching rate was obtained due to substrate treatment and Fstatistic>Ftable (38,741>0,17) H0 is rejected and H1 is accepted which reflected significant influence on tiger barb survival by reason of different substrate treatment. Hatching Rate is obtained by calculating the number of eggs hatched by tiger barbs (Puntiustetrazona). The highest hatching rate of tiger barb in this study was observed in treatment of Hydrillasp (88,14%) followed by palm fiber (72,89%) and water hyacinth (72,75%), while the lowest percentage was obtained by treatment of twigs and raffia rope.

1. Introduction
Aquaculture business, particularly ornamental fish culture, is in great demand by the community for its high potential, such as[1] trade value of ornamental fish which has exceeded the target of 850 million fish. It reached 978 million fish or 115.16 % of initial target and further increased to 1.04 billion fish in 2013. One of ornamental fish originated from Indonesia with high market share, from local to global, is tiger barb (Puntiustetrazona)[2].

Availability of quality and effective tiger barb seeds is highly limited and leads to unfulfilled market demand. Based on observation result, [3] the production of tiger barb seed is not yet optimal even though spawning process of this fish is relatively easy to perform. People normally rely on the activity to catch fish seed in the wild since production aspect of tiger barb seed is still rarely done. Limited number of tiger barb (Puntiustetrazona) culture becomes a problem that requires seriousness in its culture business. The best solution for the development of tiger barb (Puntiustetrazona) culture is possibly done through intensive system. In order to produce high quality seed, many factors are considered, such as good quality broodstock, management of feed, water quality, and spawning substrate as places to attach eggs and as tools to stimulate broodstocks to ovulate[4] [5] [6]. In their habitat, tiger barb (Puntiustetrazona) normally use Hydrillasp as place to attach their eggs. Despite different substrates used by fish farmers in tiger barb culture, information about type of substrate
preferred by tiger barb to optimally attach/lay their eggs is still limited. Therefore, the study titled “Tiger Barb (Puntiustetrazona) Spawning Using Different Substrates” was conducted.

2. Methods
The study was conducted from April - May 2018 in the Laboratory of Aquaculture, Faculty of Agriculture, the University of Asahan.

2.1 Hatching Rate/HR
Hatching rate is defined as the percentage of hatched eggs to fertilized eggs. Observation was done when hatched eggs were no longer observed. Hatching Rate is determined using the formula:

\[ HR = \frac{\text{Number of hatched eggs}}{\text{Number of fertilized eggs}} \times 100\% \]  \hspace{1cm} (1)

2.2 Survival Rate/SR
Survival Rate is the percentage of fish still alive which is calculated from stocking until the end of observation. Survival rate of larva in this study is the percentage of number of live larvae during the yolk sac phase:

\[ SR = \frac{\text{Number of fish at the end of observation}}{\text{Number of fish at the beginning of observation}} \times 100\% \]  \hspace{1cm} (2)

2.3 Fecundity
Gravimetric method is commonly applied to measure fecundity. Its principle is basically similar to volumetric method, yet the volume unit is changed to weight unit. The formula is written as follows:

\[ F = \frac{G}{Q^N} \]  \hspace{1cm} (3)

Description:
F : Fecundity
G : Body weight (initial weight of fish)/gram
Q : Gonad weight of sample/gram
N : Number of egg of sample/egg

2.4 Data Analysis
Experimental design applied in this study is the Completely Randomized Design (CRD) with 5 treatments and each treatment was replicated 20 times. Analysis was done using the software SPSS ver.21 following the equation below:

\[ Y_{ij} = \mu + \Pi + \sum_{ij} \]  \hspace{1cm} (4)

where:
Y_{ij} : Value of observation; \( i=1,2,3...n \)
\( \mu \) : General mean
\( \Pi \) : Effect of the-\( i \)th treatment; \( i=1,2,3...n \)
\( \sum_{ij} \) : Effect of error due to the-\( j \)th replication of the-\( i \)th treatment
\( i \) : \( A_0, A_1, A_2, A_3, A_4 \) (treatment)
\( j \) : 0, 1, 2, 3, 4 (replication)

3. Results and Discussion
3.1 Fecundity
Number of eggs produced by fish that are attached and ovulated by tiger barbs (Puntiustetrazona) on each treatment substrates of Hydriopsis, water hyacinth, raffia rope, twigs, and palm fiber was observed to have different percentage. Ovulation process is the release of egg from its follicle to further enter lumen or abdominal cavity [7][8]. Broodstock of matured tiger barbs (Puntiustetrazona) were used in this study with average weight of 0,27-0,35 gram.
Based on the result of study conducted on tiger barbs (*Puntiustetrazona*), eggs were found mostly attached on palm fiber of approximately 941 eggs, *Hydrilla* sp of 894 eggs, and water hyacinth of 792 eggs, yet no eggs were found attached on raffia rope and twigs. Moreover, the highest hatching rate was obtained by treatment of *Hydrilla* sp (88.14%) followed by water hyacinth (74.56%), and palm fiber (72.89%). Eggs did not hatch on substrate of raffia rope and twigs. Detail result is presented in Figure.

![Fecundity](image)

**Figure 1.** Total Number of Eggs Attached on Each Substrate

Result of analysis of variance (ANOVA) showed that $F_{\text{statistic}} > F_{\text{table}} (636.097 > 0.17)$, thus $H_0$ is rejected and $H_1$ is accepted, indicating that different substrate treatment significantly affected tiger barb fecundity, as shown in Appendix 1.

### 3.2 Hatching Rate

Hatching Rate is obtained by calculating the number of eggs hatched by tiger barbs (*Puntiustetrazona*). The highest hatching rate of tiger barb in this study was observed in treatment of *Hydrilla* sp (88.14%) followed by palm fiber (72.89%) and water hyacinth (72.75%), while the lowest percentage was obtained by treatment of twigs and raffia rope. Detail result is depicted in Figure.

![Hatching Rate](image)

**Figure 2.** Hatching Rate of Tiger Barbs (*Puntiustetrazona*)

Result of ANOVA (analysis of variance) showed that $F_{\text{statistic}} > F_{\text{table}} (353.676 > 0.17)$ or $H_0$ is rejected and $H_1$ is accepted, thus treatment of different substrate significantly influenced hatching rate of tiger barb, as presented in Appendix 2.

### 3.3 Survival Rate

Survival Rate is obtained through by calculating the percentage of tiger barb larvae (*Puntiustetrazona*) that survived the yolk sac phase. Survival rate of larvae in this study is the percentage of larvae observed still alive during the yolk sac phase.

Based on the result of the study, the highest survival rate of tiger barb larvae (*Puntiustetrazona*) was obtained by treatment of *Hydrilla* sp, followed by palm fiber and water hyacinth. Survival rate of fish larvae in treatment of raffia rope and twigs was zero due to the absence of spawning process done
by tiger barbs (Puntiustetrazona). Survival rate of tiger barb larvae (Puntiustetrazona) maintained during yolk sac phase is shown in Figure.

Result of analysis of variance (ANOVA) showed that $F_{\text{statistic}} > F_{\text{table}}$ (38.741 > 0.17) or $H_0$ is rejected and $H_1$ is accepted, reflecting significant result on survival rate of tiger barb (Puntiustetrazona) due to different substrate treatment. Detail description is found in Appendix 3.

**Figure 3.** Survival Rate of Tiger Barbs Larvae (Puntiustetrazona) during Yolk Sac Phase

### 3.4 Discussion

Based on the result of study conducted on tiger barbs (Puntiustetrazona), eggs were found mostly attached on palm fiber of approximately 941 eggs, Hydrillasp of 894 eggs, and water hyacinth of 792 eggs, yet no eggs were found attached on raffia rope and twigs. Moreover, the highest hatching rate was obtained by treatment of Hydrillasp (88.14%) followed by water hyacinth (74.56%), and palm fiber (72.89%).

Eggs were mostly found in palm fiber since this substrate was put at the bottom of aquarium, thus facilitating fish to attach their adhesive eggs. In addition, fibrous texture of palm fiber also stimulates fish to ovulate. During spawning process, fish will chase one another at the bottom of aquarium or between palm fiber since the substrate was put at the bottom of aquarium, therefore minimizing the chance for eggs to fall into the bottom of aquarium. According to [6][9][10], besides the position of substrate, number of eggs attached on substrate is also affected by sanitation and number of fibrous layer where eggs were attached on, thus more substrate means higher number of eggs attached.

The use of raffia rope and twigs as substrate for fish to attach eggs was found to produce the lowest fecundity since raffia rope is slippery for tiger barbs (Puntiustetrazona) to attach their eggs. Moreover, raffia rope could also bind particles or dirt in the aquarium, thus egg microphyll is possibly entered by other particle, closes, and makes it difficult for sperm to enter. The broodstock of tiger barbs (Puntiustetrazona) were found to be uncomfortable with the presence of synthetic substrate which contains chemical substance. In fact, chemical compound in raffia rope could inhibit the development of embryo during incubation period [11][12][9]. Furthermore, substrate of twigs was observed to have rough and inflexible texture which was found to be unattractive by female tiger barb (Puntiustetrazona) to ovulate since placement of eggs on the substrate is influenced by texture and position of substrate[3][13].

Hatching Rate is determined by calculating the number of eggs hatched by tiger barbs (Puntiustetrazona). The highest hatching rate of tiger barb in this study was observed in treatment of Hydrillasp (88.14%) followed by palm fiber (72.89%) and water hyacinth (72.75%), while the lowest percentage was obtained by treatment of twigs and raffia rope.

It was observed that Hydrillasp plant was extending upwards to the water surface, thus preferred by female fish to attach their eggs. Moreover, concentration of dissolved oxygen in Hydrillasp was higher than that in treatment of palm fiber. [14][15] In fact, Hydrillasp is commonly used by tiger barbs (Puntiustetrazona) to attach their eggs in nature. Even though eggs were mostly found in palm fiber, yet hatching rate of those eggs were lower than that in Hydrillasp since palm fiber is too dense, thus
hindering sperms to fertilize the eggs. [9] When the movement of sperms to eggs is hampered, sperms would turn their direction or lose the energy to move which might result in sperm death before fertilizing the eggs.

Survival rate is the comparison between the number of fish at the end of certain rearing period and the number of live fish at the beginning of the period. Eggs will hatch and develop into larvae. The process of larva rearing was done properly. Based on the result of the study, the highest survival rate of tiger barb larvae (Puntiustetrazona) was obtained by treatment of Hydrillasp, followed by palm fiber and water hyacinth, yet survival rate of fish larvae in treatment of raffia rope and twigs was found. Result of ANOVA is presented in Appendix 3.

In this study, larvae were only observed during the yolk sac phase, namely from eggs hatched until the yolk was completely eaten which took around 1-4 days. Based on the observation, the yolk sacs of tiger barbs were not fully disappeared at the same time as they could disappear on day-2, 3 or day-4. Larvae start to adapt and search for foods around them immediately after the yolk sac is completely disappeared [6].

The high survival rate found in treatment of Hydrillasp has resulted from the high concentration of dissolved oxygen produced by Hydrillasp, thus supplying oxygen in the spawning tank that used Hydrolla sp. Horvath and Peteri (1980) mentioned that dissolved oxygen and temperature greatly affect ovulation. Furthermore, low survival rate in treatment of raffia rope and twigs was caused by different concentrations of dissolved oxygen between treatment of Hydrillasp and raffia rope and twigs.

Hatching rate is also affected by internal factors, such as hormone and yolk volume and external factors, namely temperature, dissolved oxygen, and light intensity [16]. Poor water quality will hinder the growth of embryo, thus facilitating pathogen to attack eggs [3].

Factors of water quality play important role in tiger barb hatching. Spawning tiger barb broodstock observed in this study indicated that water quality during spawning process was still within the range that is suitable for fish production. Excellent environmental conditions for tiger barbs in their tropical nature environment include pH 6-8, DO ≥ 5, and temperature 24–28 °C, while spawning process is optimal at temperature 28 °C (Verhoef - Verhallen 2000). Water temperature during study ranged between 24–26 °C, while pH and DO ranged from 6.2–7.8 and 4.10–5.22 ppm, respectively.

4. Conclusions

Based on the result of analysis of variance (ANOVA), Fstatistic>Ftable (636.097>0,17), thus H0 is rejected and H1 is accepted, indicating that different substrate treatment significantly affected tiger barb fecundity. Similar result was observed in hatching rate and survival rate where Fstatistic>Ftable (353.676>0,17) or H0 is rejected and H1 is accepted, showing that treatment of different substrate significantly influenced hatching rate of tiger barb and Fstatistic>Ftable (38,741>0,17) or H0 is rejected and H1 is accepted, reflecting significant result on survival rate of tiger barb due to different substrate treatment.

References
[1] [KKP] Kementerian Kelautan dan Perikanan, “Pedoman Umum Industrialisasi Kelautan Dan Perikanan,” J. Chem. Inf. Model., 2012.
[2] E. NOVIANTO, L .y ’. 2004.
[3] S. Kirankumar and T. J. Pandian, “Production of androgenetic tiger barb, Puntiustetrazona,” Aquaculture, vol. 228, no. 1–4, pp. 37–51, 2003, doi: 10.1016/S0044-8486(03)00132-7.
[4] Z. Arifin and Rumondang, “Pengaruh Pemberian Suplemen Madu Pada Pakan Terhadap Pertumbuhan Dan FCR Ikan Lele Dumbo (Clariasgariepinus),” J. Fish., vol. 1, no. 1, pp. 1–11, 2017.
[5] Rumondang, “Kajian Makanan Ikan Dan Waktu Makan tangkap langsung menggunakan jaring Fakultas Pertanian Universitas Asahan menggunakan buku Illustrations Of Freshwater Plankton Of Japan. Setiap selama penelitian maka dilakukan suhu, kecepatan arus , kecerahan , Inde,” in Prosiding seminar nasional multidisplin ilmu, no. November, 2018, pp.
398–407.

[6] A. L. Sinaga and R. J. P. Batubara, “Pengaruh Pemberian Pakan Terhadap Tingkat Kematangan Gonad Ikan Putak (Notopterus notopterus),” pp. 1–16, 2018.

[7] M. Kobayashi, K. Aida, K. Furukawa, Y. Kok Law, T. Moriwaki, and I. Hanyu, “Development of sensitivity to maturation-inducing steroids in the oocytes of the daily spawning teleost, the kisu Sillago japonica,” Gen. Comp. Endocrinol., vol. 72, no. 2, pp. 264–271, 1988, doi: 10.1016/0016-6480(88)90209-2.

[8] L. Liu, R. Zhang, X. Wang, H. Zhu, and Z. Tian, “ Transcriptome analysis reveals molecular mechanisms responsive to acute cold stress in the tropical stenothermal fish tiger barb (Puntiustetrazona),” BMC Genomics, vol. 21, no. 1, pp. 1–14, 2020, doi: 10.1186/s12864-020-07139-z.

[9] T. Patria, M. Pemijahan, I. Maskoki, D. Menggunakan, B. Substrat, and D. Bakti, “TOMMY PATRIA MARBUN. Pemijahan Ikan Maskoki (.”

[10] A. K. Silaban and S. Usman, “Pengaruh Pemberian Pakan Alami Berbeda terhadap Pertumbuhan dan Kelangsungan Hidup Larva Ikan Nila (Oreochromis Niloticus),” vol. 4, no. 1, pp. 121–138, 2018, [Online]. Available: https://doi.org/10.1016/j.cell.2017.12.025%0A http://www.depkes.go.id/resources/download/info-terkini/hasil-riskesdas-2018.pdf%0A http://www.who.int/about/licensing/.

[11] M. Barik, I. Bhattacharjee, A. Ghosh, and G. Chandra, “ Larvivorous potentiality of Puntiustetrazona and Hyphessobryconrosaceus against Culexvishnui subgroup in laboratory and field based bioassay 06 Biological Sciences 0602 Ecology,” BMC Res. Notes, vol. 11, no. 1, pp. 1–5, 2018, doi: 10.1186/s13104-018-3902-8.

[12] A. Teknologi, S. Solusi, D. Bidang, and P. Secara, “ISBN : 978-602-72574-5-0 ISBN : 978-602-72574-5-0,” no. November, pp. 19–20, 2015.

[13] S. Wargasasmita, J. Biologi, D. Pusat, S. Biodiversitas, and K. Fmipa-Ui, “Ikan Air Tawar Endemik Sumatra Yang Terancam Punah (The freshwater fishes of endemic of Sumatra that threatened species),” Jurnal Iktiologi Indonesia., vol. 2, no. 2, pp. 4–49, 2002.

[14] Y. Nagahama, “17α, 20β-Dihydroxy-4-pregnen-3-one: A Teleost Maturation-Inducing Hormone,” Development, growth & differentiation, vol. 29, no. 1. pp. 1–12, 1987, [Online]. Available: http://onlinelibrary.wiley.com/doi/10.1111/j.1440-169X.1987.00001.x/abstract.

[15] Harniarti, Munir, and M. A. Akib, “Kualitas Jamu Ternak Pada Berbagai Bentuk Sediaan dan Kemasan Prosiding Seminar Nasional 2018 Seminar Nasional Sinergitas Multidiisiplin Ilmu Pengetahuan dan Teknologi (SMIPT),” Semin. Nas. Sinergitas Multidiisiplin Ilmu Pengetahuan dan Teknol., vol. 1, no. April, pp. 223–229, 2018.

[16] Rumondang dan E. Paujiah, “Kondisi Plankton Pada Tambak Ikan Kerapu Di Desa Mesjid Lama Kecamatan Talawi Kabupaten Batu Bara, Sumatera Utara,” DEPIK J. Ilmu-Ilmu Perairan, Pesisir dan Perikan., vol. 9, no. 1, pp. 107–118, 2019, doi: 10.13170/depik.9.1.14282.