Journal of Vocational in Aquaculture
Available online at https://journal.ipb.ac.id/index.php
ISSN 3109-7731
JAVA

Research Article OPEN ACCES

Effects of Subtrate Variation on the Reproductive Effectiveness of *Corydoras julii*

Habiibii Tarish Zufar[1], Cecilia Eny Indriastuti[1*], Andri Iskandar[1] and Riva Hafidah[1]

[1] Program Studi Teknologi dan Manajemen Pembenihan Ikan, Sekolah Vokasi, IPB University, Bogor, Indonesia

[*] Correspondence author:
Cecilia Eny Indriastuti
cecilia.eny@apps.ipb.ac.id
Jl. Kumbang No.14, Bogor City, West Java 16128

Received: 1 Okt 2025
Revised: 15 Okt 2025
Accepted: 29 Okt 2025

https://doi.org/10.29244/nsm29830

Abstract

Corydoras julii is a freshwater ornamental fish species highly favored in both local and international markets. However, breeders often face challenges in achieving optimal egg production, which is suspected to be influenced by the type of spawning substrate used. This study aimed to determine the most effective substrate for improving the spawning performance of *C. julii*. The experiment was conducted using a completely randomized design (CRD) with four treatments and three replications, consisting of no substrate (control, K), raffia string (T), PVC pipe (P), and *Hydrilla verticillata* (H). The parameters observed included egg productivity, fertilization rate, hatching rate, and larval survival rate. The results showed that the highest egg productivity was obtained in the PVC pipe treatment, with an average of 2081 ± 125.83 eggs. In conclusion, the PVC pipe was identified as the most effective substrate for enhancing egg productivity in *C. julii* breeding without negatively affecting other reproductive parameters.

Keywords: *Corydoras julii*, egg productivity, *Hydrilla verticillata,* PVC pipe, raffia thread, substrate.

I. INTRODUCTION

One of the aquaculture businesses commonly undertaken by farmers is the cultivation of ornamental fish. Ornamental fish farming provides substantial economic benefits, as ornamental fish possess high market value and are exported to various countries (Pamulu, 2017). Based on data obtained in recent years, ornamental fish production has continued to increase from 1.51 billion individuals in 2023 to 1.58 billion in 2024 (KKP, 2025). Indonesia's major export destinations for ornamental fish include China, the United States, Japan, South Korea, and other countries.

Corydoras julii is a freshwater ornamental fish species with high economic value and strong market demand, both domestically and internationally. As a member of the catfish group, Corydoras exhibits distinctive body patterns and coloration, making it visually appealing and popular among aquaculture practitioners. Beyond its morphology and coloration, Corydoras also has unique characteristics, such as its ability to help clean algae within aquariums (Amjad, 2017). This species is also known for its peaceful temperament, allowing it to be kept alongside other ornamental fish species in the same aquarium (Sidik, 2016).

Spawning plays a crucial role in the success of larval rearing in aquaculture. One of the key factors supporting successful spawning is the provision of an appropriate substrate (Dupamana *et al.,* 2020; Putri *et al.,* 2024). Suitable spawning substrates help protect eggs from damage caused by water currents or abrasion, maintain egg quality by reducing the accumulation of waste or pathogenic microorganisms around the eggs, and facilitate egg harvesting or collecting. The number of eggs that attach to the substrate is influenced by the substrate cleanliness (Yusanti *et al.,* 2025). However, many farmers still rely on glass surfaces as spawning substrates due to their practicality, while alternative substrates, such as raffia fibers, PVC pipes, and Hydrilla plants are less commonly used for spawning induction and egg deposition.

State-of-the-art research indicates that substrate type can significantly influence egg quantity and hatching success in Corydoras. Previous studies have shown that raffia fibers produced an average of 293 eggs (Pangestu, 2015), Hydrilla yielded 288 eggs (Marchaka *et al.,* 2021), and PVC pipes resulted in 556 eggs (Abdillah, 2024). However, these studies generally focused on single substrate types and did not specifically compare these substrates for *Corydoras julii* within the same rearing environment. Moreover, information related to the substrate preferences of *C. julii* remains insufficiently documented to date.

Based on these gaps, the novelty of the present study lies in its comprehensive evaluation of multiple spawning substrates, consisting of raffia fibers, PVC pipes, and Hydrilla, specifically for *C. julii*. This approach provides new insights into species-specific reproductive behavior and substrate preferences that have not been previously addressed in the literature. Therefore, the objective of this study is to determine the most effective substrate for enhancing the spawning performance of *C. julii,* as measured through egg production, fertility rate, hatching rate, and survival rate.

II. MATERIALS AND METHODS

2.1. Location and Time

This research was conducted from December 2024 to February 2025. The study was conducted at Fajar Aquatic, located on Jalan Ikan Hias, RT. 02/ RW.09, Cibadak, Tanah Sereal District, Bogor City, West Java. The location map is presented in Figure 1.

2.2. Material

The equipment used in this study included aquariums (45 × 50 × 30 cm³), aquarium racks, water hoses, siphon hoses, fish nets, coconut fiber filters, basins, sponges, biofoam, thermometer, pH meter, DO meter, TDS meter, test kits, raffia fibers, PVC pipes,

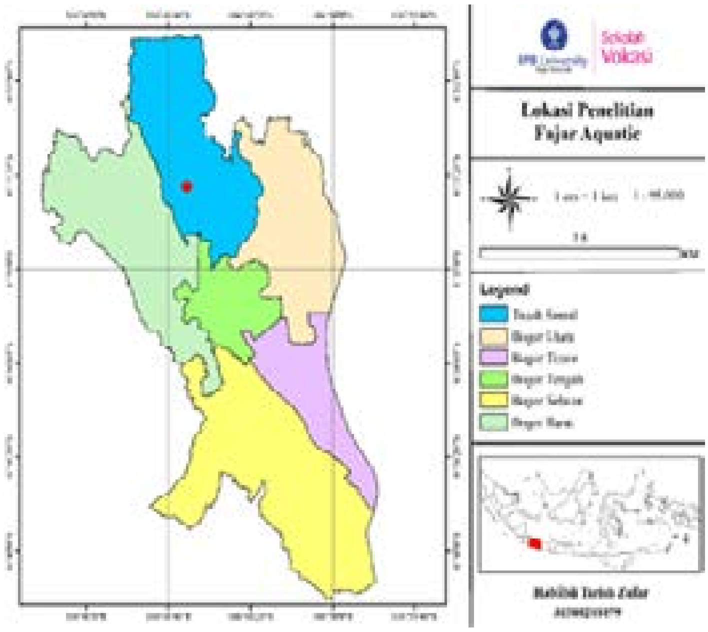

Figure 1. Location map of Fajar Aquatic, Bogor City, West Java.

and Hydrilla plants. The materials used consisted of *Corydoras julii*, *Tubifex* sp. (worms), and methylene blue.

2.3. Research Design

This study employed a completely randomized design (CRD) consisting of four treatments and three replicates. The selection of spawning substrates for *Corydoras julii* was based on several previous studies that demonstrated favorable results. Each substrate was placed in an aquarium according to the assigned treatment code and stocked with the experimental fish. The substrates were positioned in the corner of the aquarium, following the natural spawning behavior of Corydoras fish during egg deposition.The treatment design used in this study is presented in Table 1.2.4. Calculation of Survival

Table 1. Experimental design for evaluating *Corydoras julii* spawning performance under different substrates.

Treatment	Description	Reference
K	Without substrate	-
T	Raffia substrate	Mustahal *et al.,* 2014
P	PVC pipe substrate	Abdillah, 2024
H	Hydrilla substrate	Marchaka *et al.,* 2021

2.4.Research Procedure

2.4.1 Preparation of Rearing Containers

The rearing containers used in this study consisted of 12 aquariums measuring 45 × 50 × 30 cm³, each equipped with an aerator and biofoam to supply oxygen and filter waste. Supporting equipment for daily aquarium maintenance included a siphon hose, sponge, water-filling hose, and fish net for removing residual debris. The aquariums were cleaned by scrubbing the walls and bottom surfaces using a sponge (Damayanti, 2024). After cleaning, each aquarium was filled with water to a height of 20 cm. The water used originated from a well and was stored in a reservoir for 24 hours prior to use.

2.4.2 Preparation of Fish

The *Corydoras julii* broodstock used in this study originated from Fajar Aquatic and had been maintained for 30 days prior to the experiment. The fish consisted of one-year-old broodstock, comprising 72 males and 36 females. Sexual dimorphism was identified based on body shape and size, with males exhibiting a slender, torpedo-like body, whereas females exhibit a more rounded body shape (Abdillah, 2024).

2.4.3 Preparation of Substrates

The substrates used in this study were raffia fibers (Mustahal *et al.,* 2014), PVC pipes (Abdillah, 2024), and Hydrilla plants (Marchaka *et al.,* 2021). Each substrate was placed in the aquarium according to the treatment code and after the broodstock had been introduced. The substrates were positioned in the corners of the aquarium, following the natural spawning behavior of Corydoras, which typically deposit eggs in such areas.

2.4.4 Feeding

The feed used in this study consisted of natural feed in the form of Tubifex sp. worms. The nutritional composition of Tubifex consists of 2.04% crude fiber, 57% protein, 3.6% ash, and 13.3% fat (Wijayanti, 2018). Feeding was carried out twice daily, at 08:00 and 15:00 (Gumulya, 2022). The ad libitum feeding method was applied to ensure continuous feed availability (Veronica, 2021)

2.3.5 Spawning

Spawning was conducted naturally and in mass, using a male-to-female ratio of 2:1. Each aquarium was provided with a substrate placed in the corner of the tank to serve as an egg-laying site. Corydoras typically spawn in the early morning, between 05:00 and 07:00 (Pratiwi, 2022).

2.3.6 Hatching of eggs

Egg collection was carried out in the morning following spawning. The eggs were harvested by gently lifting the substrate containing the attached eggs for counting and observation. After enumeration and inspection, eggs showing no signs of fungal infection were transferred into the hatching aquarium that had been pre-treated with methylene blue to prevent fungal contamination.

2.3.7 Water Quality

Water quality parameters measured included temperature, pH, dissolved oxygen (DO), ammonia, and total dissolved solids (TDS). Measurements of temperature, pH, and DO were conducted daily in the morning and afternoon, while ammonia and TDS were measured once a week in the morning. All measurements were conducted in situ. Temperature was measured using a thermometer, pH using a pH meter, DO using a DO meter, TDS using a TDS meter, and ammonia concentration using a Tetra® test kit.

2.4 Observation Parameters

Egg productivity was assessed by counting the total number of eggs produced daily by the broodstock, including both fertilized and unfertilized eggs (Putra, 2020). The fertilization rate was defined as the percentage of eggs successfully fertilized by sperm. Fertilized eggs appeared transparent and gradually turned brownish until hatching, whereas unfertilized eggs appeared milky white (Subekhi *et al.,* 2022). The hatching rate was calculated as the percentage of eggs that successfully hatched (Fariedah *et al.,* 2018). The survival rate represented the percentage of fish remaining alive at a given time relative to the initial number of fish stocked (Arzad *et al.,* 2019)

2.5 Observation Parameters

The collected data were tabulated using Microsoft Excel 2016 and statistically analyzed using SPSS version 27. Data analysis began with a normality test, followed by analysis of variance (ANOVA). When significant differences were detected ($p < 0.05$), Duncan's multiple range test was applied to identify significant differences among treatments. The results were subsequently discussed in comparison with relevant literature. Water quality data were analyzed descriptively and compared with published reference values.

III. RESULT

3.1 Egg productivity

Egg productivity was assessed based on the total number of eggs produced. The application of different substrates resulted in significant differences in egg productivity ($p < 0.05$). The highest egg productivity was observed in the PVC pipe substrate treatment (P), with an average of 2081 ± 125.83 eggs. In contrast, the lowest egg productivity was recorded in the treatment without substrate (K) and the Hydrilla substrate (H), with averages of 1555 ± 51.39 eggs and 1422 ± 114.59 eggs, respectively (Figure 3).

3.2 Fertilization rate

The fertilization rate of *Corydoras julii* eggs was determined based on the number of fertilized eggs. The application of different spawning substrates did not result in significant differences in fertilization rates ($p>0.05$). The fertilization rates across treatments ranged from 84–85% (Figure 4).

3.3 Hatching rate

The hatching rate of *Corydoras julii* eggs was evaluated based on the proportion of eggs that successfully hatched. The application of different substrates during the spawning of *C. julii* did not result in significant differences in hatching rate ($p>0.05$). The hatching rate across all treatments was approximately 85% (Figure 5).

3.4 Survival Rate

The survival rate of *Corydoras julii* larvae was calculated based on the number of fish that survived until the end of the rearing period. The application of different substrates in the spawning of *Corydoras julii* did not result in a significant differences in larval survival rate ($p>0.05$). Survival rates ranged from 84–85% among treatments (Figure 6).

IV. DISCUSION

The PVC pipe substrate produced the highest productivity, likely due to its texture, which is preferred by broodstock for spawning, as it is rough, coarse, and opaque. According to Amjad (2017), Corydoras broodstock feel more comfortable placing their eggs on PVC pipes because of the rough surface underwater and opaque material. This findings aligns with Septihandoko *et al.,* (2021), who stated that egg productivity in fish increases when broodstock stress is minimized. Fish that perceive threats experience stress, which in turn reduces their reproductive performance (Mileva *et al.,* 2011).

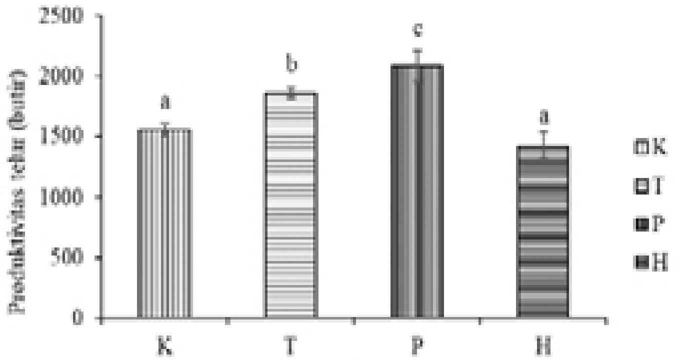

Figure 3. Egg productivity of *Corydoras julii* using different spawning substrates. (K) without substrate, (T) raffia rope substrate, (P) PVC pipe substrate, and (H) Hydrilla substrate.

Lower productivity was observed in the Hydrilla plant and raffia string substrates due to differences in material characteristics. Raffia string has a smooth surface, making egg attachment difficult, while Hydrilla plants have slippery, branched stems that hinder broodstock from depositing eggs effectively (Marchaka *et al.,* 2021). Reduced stress in broodstock correlates with lower cortisol levels, which enhances vitellogenesis and spermatogenesis (Rasyid *et al.,* 2025; Arief, 2011). Optimized vitellogenesis aligns with increased oocyte production in the ovaries (Dhewantara and Rahmatia, 2017).

Substrate type can also influence the hypothalamus, regulating reproductive hormone production (Marchaka *et al.,* 2021). Appropriate substrates stimulate the hypothalamus to release follicle-stimulating hormone (FSH) and luteinizing hormone (LH) (Syaifudin *et al.,* 2000). The more FSH and LH produced, the more eggs

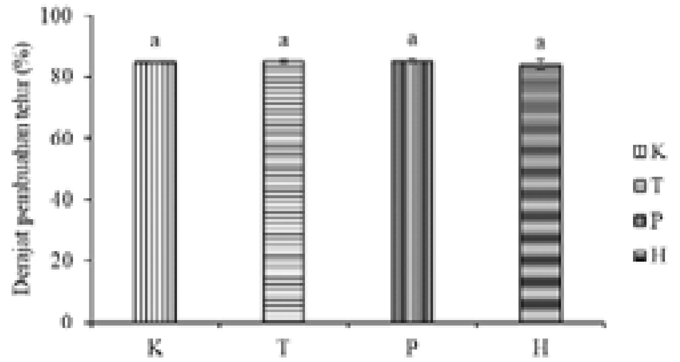

Figure 4. Fertilization rate of *Corydoras julii* on different spawning substrates. (K) without substrate, (T) raffia rope substrate, (P) PVC pipe substrate, and (H) Hydrilla substrate.

https://doi.org/10.29244/nsm29830

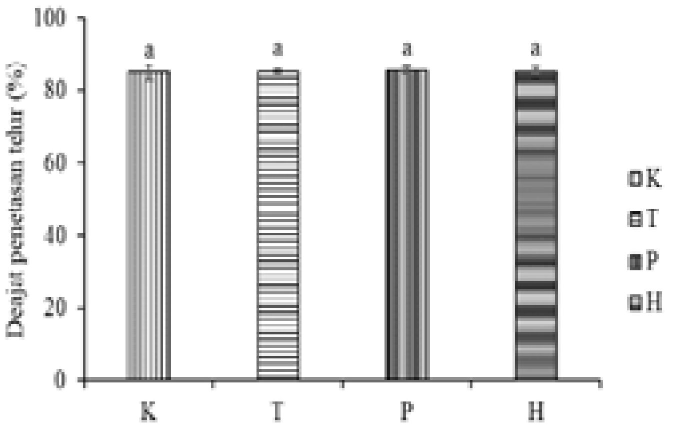

Figure 5. Hatching rate of *Corydoras julii* eggs on different spawning substrates. (K) without substrate, (T) raffia rope substrate, (P) PVC pipe substrate, and (H) Hydrilla substrate.

will be produced (Feronyca *et al.,* 2024). FSH plays a role in vitellogenesis and gonadal maturation, while LH regulates the synthesis of reproductive hormones (Muslim, 2019).

The water quality during the spawning and hatching remained within optimal ranges. The temperature ranged from 24–26°C, pH from 6–7.5, and DO from 5–7 mg/L. These conditions align with Diatin (2016), who reported that Corydoras thrive at temperatures of 24–30°C, pH 6–8, and DO of at least 3 mg/L. The ammonia concentration remained below 1.5 mg/L, consistent with Rezki *et al.,* (2022), who stated that concentrations above 1.5 mg/L are toxic. The TDS obtained ranged between 95–135 ppm, still within the safe limits (<200 ppm) for fish survival (Tiffany *et al.,* 2022).

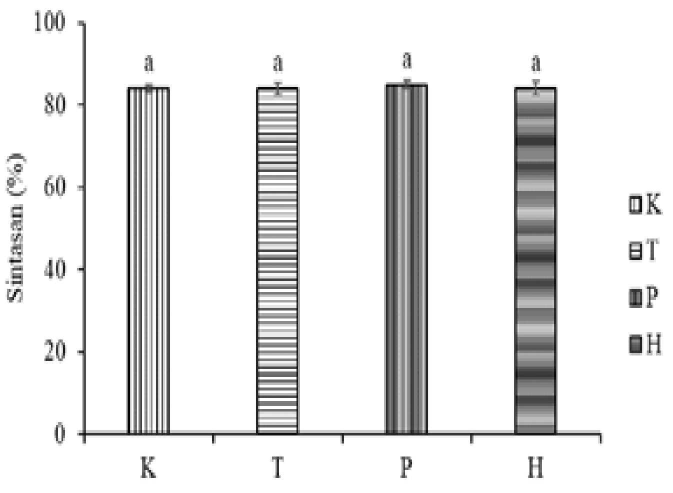

Figure 5. Survival rate of *Corydoras julii* larvae on different spawning substrates. (K) without substrate, (T) raffia string substrate, (P) PVC pipe substrate, and (H) Hydrilla substrate.

V. CONCLUSION

The use of PVC pipe as a spawning substrate effectively enhanced the reproductive performance of *Corydoras julii*, resulting in higher egg productivity compared with raffia string, Hydrilla, or no substrate.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding financial, personal, or other relationships related to the material discussed in this manuscript.

ACKNOWLEDGEMENT

The authors extend their deepest appreciation to Fajar Aquatic for supplying the fish specimens and offering the necessary facilities to support this research

REFERENCES

Abdillah MI. 2024. Pengaruh substrat yang berbeda terhadap efektivitas pemijahan ikan Corydoras *Corydoras* sp [laporan proyek akhir]. Bogor: Institut Pertanian Bogor.

Albana MA. 2020. Embriogenesis dan perkembangan larva ikan koridoras julii (*Corydoras julii*) [skripsi]. Bogor: Institut Pertanian Bogor.

Amjad J, Yustiati A, Suryana AAH, Rosidah, Zidni I. 2017. Tingkat keberhasilan pemijahan ikan koridoras albino (C*orydoras aeneus*) dengan substrat yang berbeda pada kolam semen. *Jurnal Perikanan dan Kelautan*. 8(2): 1–6.

Ariyani A, Sukarno N, Listiyowati. 2019. Potensi cendawan asal *Hydrilla verticillata* sebagai pengendali hayati Fusarium oxysporum dan Ganoderma boninense. *Jurnal Sumberdaya HAYATI.* 5(2). 43–51

Arzad M, Ratna, Fahrizal A. 2019. Pengaruh padat tebar terhadap pertumbuhan ikan nila (*Oreochromis niloticus*) dalam sistem akuaponik. *Jurnal Median*. 11(2): 39–47.

Damayanti SF. 2024. Kinerja produksi pendederan ikan koridoras *Corydoras sterbai* dengan penambahan kunyit *Curcuma domestica* melalui pakan. Bogor: Institut Pertanian Bogor.

Dhewantara YL, Rahmatia F. 2017. Rekayasa maturase menggunakan hormon oodev terhadap ikan synodontis (*Synodontis* sp). *Jurnal Akuatika Indonesia.* 2(1): 35–42.

Diatin I. 2016. Intensifikasi budidaya ikan hias koridoras (*Corydoras aeneus*) [disertasi]. Bogor: Institut Pertanian Bogor.

Fabanjo MA, Abdullah N, Wibowo ES. 2021. Pemberian hormon ovabrim terhadap fertilizasi pada ikan nila merah (*Orecromis nilaticus*). *Jurnal Agribisnis Perikanan.* 14(2):

286–291.

Fariedah F, Inalya I, Rani Y, A' yunin Q, Evi T. 2018. Penggunaan tanah liat untuk keberhasilan pemijahan ikan patin siam siam (*Pangasianodon hypophthalmus*). *Jurnal Ilmiah Perikanan dan Kelautan.* 10(2): 91–94.

Gultom VDN. 2022. Pengaruh rasio jantan dan betina terhadap proses reproduksi ikan koridoras (*Corydoras trilineatus*). *Jurnal Ilmiah Jurusan Budidaya Perairan*. 7(1): 1–6.

Gumulya NK. 2022. Budidaya ikan *corydoras julii Corydoras julii* dan ikan rasbora galaxy *Danio margaritatus* di Tetra Aquaria, Sukabumi, Jawa Barat. Bogor: Institut Pertanian Bogor.

Jayasukmana D. 2009. Inventarisasi parasite pada benih ikan corydoras (*Corydoras albino*) pada berbagai ukuran. Bogor: Institut Pertanian Bogor.

[KKP] Kementrian Kelautan dan Perikanan. 2021. Budidaya ikan hias tingkatkan pendapatan masyarakat di tengah pandemi. (diakses tanggal 13 Oktober 2024).

Marchaka AH, Nuraini, Aryani N. 2021. Pengaruh substrat berbeda terhadap pemijahan dan penetasan telur ikan zebra pink danio (*Brachydanio rerio*). Jurnal Akuakultur Sebatin. 2(1).

Muslim M. 2019. Pematangan gonad, pemijahan, penetasan telur dan perawatan larva ikan gabus (*Channa striata*). PENA Akuatika. 18(2).

Nurhidayat, Zamroni M. 2012. Performa pemijahan ikan rainbow kurumoi *Melanotaenia parva* pada jenis substrat yang berbeda. Dalam prosiding hasil penelitian perikanan dan kelautan IX. Yogyakarta, Indonesia.

Okavianti V, Cokrowati N, Setyono BDH. 2021. Pengaruh substrat berbeda terhadap penempelan telur pada pemijahan ikan badut (*Amphiprion ocellaris*). *Jurnal Perikanan.* 11(2): 209–217.

Pamulu TWP, Yuniarti K, Mulis. 2017. Tumbuh kembang ikan black moly yang diberi pakan cacing sutera. J*ournal Ilmiah Perikanan dan Kelautan*. 5(4): 25–31.

Pangestu TM. 2015. Pengaruh substrat yang berbeda terhadap jumlah telur yang menempel dan daya tetas ikan corydoras sterbai (*Corydoras sterbai*).Malang: Universitas Brawijaya.

Pratiwi AG. 2020. Budidaya ikan corydoras adolfoi *Corydoras adolfoi* dan ikan mikro rasbora galaxy *Danio margaritatus* di Tetra Aquaria Sukabumi, Jawa Barat. Bogor: Institut Pertanian Bogor.

Putra AK. 2020. Kinerja reproduksi ikan koridoras *Corydoras palaeatus* dengan rasio kelamin induk yang berbeda [skripsi]. Bogor: Institut Pertanian Bogor.

Putri LA, Cokrowati N, Lestari PD. 2022. Tingkat penetasan telur ikan koi *Cyprinus carpio* pada jenis substrat yang berbeda. *Jurnal Biologi Tropis*. 1(1).

Putri, RS., Indra J., Sri P., Syamsul B.A., Mahfud P. 2024. Spawning grounds literature review: spawning success factors. *AACL Bioflux.* 17(3): 1008-1018.

Rasyid R, Dhewantara YL, Rahmatia F, 2025. Perbedaan salinitas terhadap pertumbuhan dan kelangsungan hidup benih ikan badut percula (*Amphiprion percula*). Ju*rnal Ilmiah Satya Minabahari*. 10(2): 86−93.

Rezki DW, Mulyana, Lesmana D. 2022. Kinerja produksi benih ikan koridoras (*Corydoras sterbai*) dengan padat tebar yang berbeda. *Jurnal Mina Sains.* 8(1): 2407–9030.

Satyani. 2008. Catfish kecil unik, *Corydoras* sp. Untuk akuarium, tingkah laku biologi dan reproduksinya. Media Akuakultur. 3(2)

Septiani. 2023. Penanganan benih ikan corydoras (*Corydoras sterbai*) pra ekspor di PT Qian Hu Joe Aquatic Indonesia. Politeknik Negeri Lampung: Bandar Lampung.

Septihandoko K, Mukti MAA, Nindarwi DD. 2021. Optimalisasi kegiatan pembenihan secara alami melalui pengamatan fekunditas, fertilization rate, hatching rate dan survival rate ikan karper (*Cyprinus carpio*). *Nekton*. 1(2): 60−71.

Sidik AB. 2016. Pengaruh padat tebar ikan Corydoras sterbai (*Corydoras aeneus*) terhadap pertumbuhan dan kelangsungan hidup ikan komet (C*arassius auratus auratus*) dengan teknologi akuaponik. Universitas Sultan Ageng Tirtayasa.

Tiffany N, Darwin N, Nurjaman DF, Hidayat MR, Winanti N. 2022. Sistem monitoring kualitas air pada akuarium budidaya ternak ikan Guppy menggunakan mikrokontroler IoT. Jurnal Teknik: Media Pengembangan Ilmu dan Aplikasi Teknik. 21(2): 144–157.

Utami PA. 2022. Budidaya ikan rainbow boesemani Melanotaenia boesemani dan corydoras sterbai *Corydoras sterbai* di pusat pelatihan mandiri kelautan dan perikanan (P2MKP) mina mulya, bekasi, jawa barat [laporan akhir]. Bogor: Institut Pertanian Bogor.

Veronica E. 2021. Kinerja produksi ikan hias dan kelayakan usaha *Corydoras paleatus* ukuran satu sentimeter pada padat terbar berbeda dengan pergantian air 30% [skripsi]. Bogor: Institut Pertanian Bogor.

Wahyuni AP, Firmansyah M, Fattah N, Hastuti. 2020. Studi kualitas air untuk budidaya ikan bandeng (*Chanos chanos* Forsskal) di tambak kelurahan samataring kecamatan sinjai timur. *Jurnal Agrominansia*. 5(1): 106–113.

Wijayanti D. 2018. Pengaruh persentase pemberian pakan alami cacing sutra (*Tubifex* sp.) dan pakan buatan terhadap frekuensi moulting dan pertumbuhan udang galah (*Macrobrachium rosenbergii*). Malang: Universitas

Muhammadiyah Malang.

Yuatiati A, Herawati T, Nurhayati A. 2015. Diseminasi penggunaan ovaprim untuk mempercepat pemijahan ikan mas di desa sukamahi dan sukagalih kecamatan sukaratu kabupaten tasikmalaya provinsi jawa barat. 4(1): 1–3.

Yusanti, IA., Sofian., Tri I. 2025. Utilization of Different Substrates on Goldfish (*Carrasius auratus*) Seeds Productivity. *Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam*. 22(1): 95-101.