The Effectiveness Of Providing Different Natural Feed Types Of Swordtail *(Xiphophorus Helleri)* Broodstock On Crude Birth Rate (Cbr)

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Abstract

The most important factor in speeding up fish depends on the food given. The feed given was in the form of artificial feed (pellets) because of the practicality of its availability. However, commercially made feed was of course more expensive, and can pollute the air compared to natural feed which was easy and can be in the surrounding environment. For this reason, it was necessary to look for natural feed as an effective and efficient alternative feed to ripen the gonads of male and female swordtail. The research used a completely randomized design with 4 treatments and 3 repetitions and arranged randomly. Treatment by giving different natural food to the broodstock swordtail: treatment A (commercial pellets), B (Daphnia/Moina), C (blood worms) and D (mosquito larvae feed). Each broodstock treatment used was 27 females and 9 males (ratio 1: 3). The results of water quality measurements of all treatments with an average DO 4 mg/L, temperature 26 to 27°C, pH 7-8 and 30 mg/L hardness, thus showing the water quality during the research, the water condition was suitable for the maintenance of broodstock of swordtail, so that it supported growth. and breed of swordtail to produce tillers. The results showed that the highest average birth rate of swordtail broodstock produced in treatment D were 141 fish followed by treatment B 125 fish, then treatment C of 117 fish. and the lowest was in treatment A with a birth rate of 102 fish.

Keyword: Crude Birth Rate, Natural Feed, Swordtail Broodstock

Introduction

Swordtail market opportunities had never receded even though since ornamental fish became popular in Indonesia. Swordtail, molly, guppy and hickey were almost always available in the ornamental market (Kuncoro, 2011). The availability of swordtail was determined by the availability of sufficient quality and quantity of seeds to be raised. The availability of swordtail seeds was determined by the reproductive factors of the broodstock swordtail to produce fish chicks of good quality and sufficient quantity. The success of the broodstock swordtail spawning, the most important factor in accelerating reproduction depends on the food given. Generally, to increase the reproduction of platies using artificial feed with practical considerations in its availability. However, artificial feed was certainly more expensive, and it was easy to pollute the waters compared to natural feed that was easily available in nature or cultivated natural feed. Besides that, natural food has a better and complete nutrient absorption rate than artificial feed, so it was necessary to look for natural feed as an alternative feed.

Natural feed for platies was adjusted to the mouth opening of the swordtail. Natural food that was commonly found in nature either in rivers or trenches includes: mosquito larvae, hair worms (silk worms), blood worms, and rotifer species commonly found were *Brachionus* sp, *Daphnia* sp., *Moina* sp. (Lesmana, 2009). Naturally, this natural food contains different nutrients that can affect the increase in the reproduction of the swordtail.

Based on this problem, the research was needed to determine the reproductive rate of swordtail by providing different natural foods that can accelerate the maturity of the gonads so that effective and efficient food can be found. Research "The Effectiveness of Providing Different Natural Feed Types of Swordtail (*Xiphophorus helleri*) Broodstock on Crude Birth Rate".

Materials and Methods

Research Stages

The research stage carried out was the preparation of the aquarium container, after the aquarium was filled with main water, the aquarium was spread out. During spawning, the parameters monitored were feeding, water quality, fish health, survival rate of swordtail broodstock and larvae.

Preparation of Research Containers

The research container used was prepared beforehand. The research container used was an aquarium with a size of 25x50x30 cm, with 12 pieces divided into 4 groups, namely; treatment groups A, B. C and D each had 3 replications and 12 for swordtail to be maintained for up to 21 days (D_{21}) so a total of 24 aquariums was needed. The aquarium container was filled with PDAM water with a water level of 20 cm, then the water was given probiotic fertilizer, after 2 days the broodstock was spread in the aquarium. The bottom of the aquarium was given ginger coral to protect the young fish from being preyed on by the broodstock swordtail. Each broodstock was fed with different treatments of commercial pellet and natural feed.

Broodstock Swordtail Spawned

Broodstock of swordtail used were 6 to 8 months old, with a minimum length of 2 cm for males and females at least 3.5 cm with an average weight of 4.9 g obtained from CV. Multi Sector Agribusiness. The total population of swordtail used in this research were 144 fish. The test fish was put into the prepared aquarium container which was filled with water with a height of 20 cm. Broodstock male and female fish were spawned 1 male and 3 female (ratio 1: 3). The number of stocking density was 12 fish per aquarium (treatment) of 12 aquarium. The total number of broodstock that was spread was 144 fish (108 females and 36 males).

Spawning Monitoring

During the research on spawning swordtail broodstock, monitoring (control), feeding, water quality management and fish health and the survival of the broodstock swordtail were carried out.

Feeding

Broodstock fish were fed 3 times a day in the morning (08.00 WIB) afternoon (13.00 WIB) and evening (17.00 WIB). The feed given was in the form of commercial pellets and natural food (Daphnia / Moina, blood worms and mosquito larvae). Feed was given until it was full adlibitum.

Quantity and Quality Measurement of Water

Measurement of water quality parameters taken temperature, pH, DO Water quality measurements were carried out for each water sample in the maintenance container, measurements were carried out 3 times a day in the morning (08.00 WIB) afternoon (13.00 WIB) and evening (17.00 WIB) once a week and the quantity of water with a 20% water change every 1 week.

Broodstock Health Examination

Visual monitoring of the broodstock of swordtail for possible disease. Visual observation of the data taken was the type of disease that may attack, to be treated if a disease was found by immersing the drug with the recommended dose of the drug on the drug package.

Monitoring of Broodstock Survival

Furthermore, monitoring was carried out to obtain data on the survival (survival rate) of the broodstock swordtail, observations and calculations were carried out. Monitoring of swordtail population was carried out every day. The number of broodstock swordtail that died (mortality) was not changed. Monitoring for 54 days.

Maintenance of Swordtail Seeds

The count of tillers from spawning was monitored every day. The results of the harvested tillers were counted and transferred to the aquarium that kept the seeds in the aquarium, the size of 25x50x30 cm and kept for 21 days (D_{21}) During 21 days of rearing, the survival rate of the seeds was calculated. Adjusted seed harvesting between treatments. During maintenance, it was fed according to the treatment feed.

Research Location

This research was conducted at the Workshop of Aquaculture in the Research Program of Aquaculture, Department of Marine and Fisheries Sciences, Pontianak State Polytechnic.

Research Data Collection

The data collected were the main parameters (primary data) and supporting (secondary).

a. Primary data

Primary data were collected survival rate (SR) and crude birth rate (ovovivipar) from the results of the spawning of each treatment.

Broodstock Survival Rate Data

Data on the SR of swordtail broodstock by counting the number of fish alive at the beginning of stocking (N_o) and at the end of maintenance (N_t), expressed in percent. The SR can be calculated using the formula (Jatilaksono, 2007):

$$SR\ (D51) = \frac{Nt}{No} \times 100\%$$

Information :

SR = Survival Rate
Nt = Final Number (fish)
No = Initial Number (fish)

Data on Broodstock's Crude Birth Rate

Crude Birth Rate data (ovovivipar) from the results of the spawning of each treatment. The calculation was done manually by catching it, then transferring it to the aquarium to breed the swordtail larvae, then maintaining it for 21 days (D_{21}).

b. Secondary Data

Secondary data were collected on the survival rate of seeds, monitoring of spawning water quality, health of the broodstock and feeding the broodstock and seeds.

Water Quality Data

The data taken in measuring water quality were temperature measured using a thermometer, pH with pH test kit, DO used DO test kit and hardness with gH test kit. Measurement of water quality is carried out for each water sample in the maintenance container, measurements were carried out 3 times a day in the morning (08.00 WIB) afternoon (13.00 WIB) and evening (17.00 WIB) once a week

Health Data of Swordtail Broodstock

Health data of swordtail broodstock were obtained visually which indicated the possibility of disease. Visually observing the data taken was the type of disease that may attack, for treatment if a disease was found by giving the drug by immersion (dipping) with the recommended dose of the drug on the drug package.

Feed Data

Brood fish were fed 3 times a day. Treatment A, the feed given was commercial feed of NANOLIS pellets, Treatment B was fed with water fleas (Daphnia Moina) in a bag, treatment C was given blood worm feed (frozen sticks) and treatment D was fed with mosquito larvae (*Culex*) in bag. Feed was given until it was full adlibitum.

Seed Survival Rate Data

The results of the hatchlings resulting from spawning were harvested to be raised in a separate aquarium. The seeds were maintained for 21 days (D_{21}), the feed given was according to the broodstock feed treatment. Data on the SR of swordtail broodstock by counting the number of fish alive at the beginning of stocking (N_o) and at the end of maintenance (N_t), expressed in percent. The SR can be calculated using the formula (Jatilaksono, 2007):

$$SR\ (D21) = \frac{Nt}{No} \times 100\%$$

Information :

SR = Survival Rate
Nt = Final Number (fish)
No = Initial Number (fish)

Research Model

The model used in this research was an experimental method consisting of 4 levels of treatment with 3 replications, arranged using a random layout of the container. Based on the results of randomization, the placement of the container was obtained as follows:

Information :

A, B, C, D = Treatment
1,2,3..12 = Plot Number
1,2,3 = Replication

Research Design

The research design used a completely randomized design with 4 treatments and 3 replications. The main feeding treatments used in this research were Treatment A (NANOLIS pellet feed), Treatment B (Daphnia/Moina feed), Treatment C (blood worm) and Treatment D (mosquito larvae feed). Feed was given until it was full adlibitum. Aquariums were arranged randomly. Before being spread, adapted it for 5 days.

Research Data Analysis

The data that has been collected, both primary data and secondary data, were analyzed qualitatively and descriptively, data analysis was as follows:

Water Quality Compliance Level Analysis

Water quality data during the spawning of the broodstock swordtail parameter water quality temperature, pH, DO and hardness were compared with SNI standards for the quality of water for swordtail production.

The level of suitability of waters for fish cultivation was grouped into the division of water suitability classes carried out by

Hardjowigeno (2001) in Wijaya (2007), which divides the suitability of waters into 2 orders, namely the S order (suitable) and the N order (not suitable). corresponding). Water quality parameters that were suitable for the maintenance of the broodstock swordtail if the parameters were in accordance with the standard standards.

Swordtail Broodstock of Crude Birth Rate Analysis

The birth rate calculation of the broodstock swordtail was statistically tested to determine the difference in the percentage value of the birth rate of each treatment. Data analysis was performed with the help of software PASW.18.2014 one way ANOVA to determine significant differences in each treatment. The data obtained were tabulated first then multiple linear regression analysis was carried out. Multiple regression analysis was used by researchers, if the researcher intends to predict how the dependent variable was (fluctuating), if two or more independent variables as predictive factors were manipulated (their value was increased or decreased). Multiple regression analysis was carried out in this research because the number of independent variables was more than 2. The regression equation according to Sugiyono (2009).

Crude Birth Rate (CBR) $= b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4$

Information :

CBR = Crude Birth Rate
X_1, X_2, X_3, X_4 = Research variabel

The requirement used multiple linear regression equations was the fulfillment of classical assumptions to obtain an efficient and unbiased examination value or BLUE (Best Linear Unbias Estimator) from one multiple regression equation with the least squares method based on Ordinary Least Squares (OLS), it was necessary to did tested. to find out the resulting regression model met the requirements of classical assumptions or not.

If the explanatory variable was statistically significant in affecting the residuals, it was certain that this model has a heteroscedasticity problem. The data was confirmed to be normally distributed, there was no multicollinearity disorder, and the assumption of multicollinearity was not fulfilled, then the multiple regression coefficient significance test (F test) was continued to test whether simultaneously (together) the independent variables affect the dependent variable, with a confidence level of 95% ($\alpha = 0.05$) with the formula according to Sugiyono (2002), namely:

$$F_{cal} = \frac{R^2 / \ k}{(1 - R^2) / \ (n - k - 1)}$$

Information :

F cal = F calculate
R_2 = Coefficient of determination
N = Number of samples
K = Number of independent variables

The hypothesis proposed in the F Test

H_0 : Natural feeding didn't affected the CBR of swordtail broodstock
H_1 : Natural feeding affected the CBR of swordtail broodstock

The decision criteria in the F test were:

- ✓ If F table ≥ F count or sig ≤ 0.05 then H_0 was accepted and H_1 was rejected.
- ✓ If F table <F count or sig> 0.05 then H_0 was rejected and H_1 was accepted.

The next stage was to perform a partial test (t test) with the intention of partially testing the effect of the independent variable on the dependent variable with the assumption that other variables were considered constant, with a confidence level of 95% ($\alpha = 0.05$). According to Sugiyono (2002) the formula used in the t test was:

$$t_{cal} = \frac{b \ i}{sb \ i}$$

Information :

t cal = t calculate
Bi = Coefficient Regression of independent variables -i
sbi = Standard Deviation of independent variables -i

The hypothesis proposed in the t test was :

H_0 : Partially natural feeding didn't affected the birth rate of the swordtail broodstock
H_1 : Partially natural feeding affected the birth rate of the swordtail broodstock

The decision criteria in the t test were:

- ✓ If t table ≥ t count or sig ≤ 0.05 then H_0 was rejected and H_1 was accepted.
- ✓ If t table <t count or sig> 0.05 then H_0 was accepted and H_1 was rejected

Results and Discussions

The indicators observed in this research included the SR of the broodstock, the CBR seeds, fish health and water quality during spawning and the survival rate of the seeds.

Observation of the main parameters of survival and birth rates was carried out every day in order to determine the number of fish mortality and birth during the research. Meanwhile, observation of supporting parameters of data supporting fish health, water quality and sampling was carried out periodically. The main parameter data that has been obtained, namely the birth rate data will be processed with the normality test and the LSD test used the SPSS Version 23 software tool for supporting data such as the graduation rate of broodstock and seed life, fish health, water quality using descriptive analysis.

Observation of Broodstock Swordtail's Life Passage Rate

The main population of the swordtail in this research were 144 fish in 12 spawning aquariums. Monitoring the survival of swordtail broodstock by observing the count of test fish. The survival rate of swordtail broodstock was the number of fish alive at the end of the research reduced by the number of fish spawned (stocking). During the research, the SR data of swordtail were presented in Table 1 as followed:

Table 1. Survival Rate Data of Swordtail Broodstock during research

Feed Treatment	Number of Swordtail Broodstock		SR (%)
	First (fish)	Final (fish)	
A	36	33	91,66%
B	36	35	97,22%
C	36	34	94,44%
D	36	36	100%
Total	144	138	

Source: Results of survival sampling for swordtail broodstock during research (2020)

Table 1 showed that during the research, 144 fish were stocked after being raised for 54 days when the swordtail were observed at the time of the final observation, there were 138 dead fish found (mortality). Treatment A was given commercial pellet feed with SR 33 levels (91.66%), Treatment B was given water flea feed (Daphnia/Moina) SR 35 fish (97.22%), treatment C was given blood worm feed (SR 35 blood worm) (94.44%), and treatment D was fed with mosquito larvae (*Culex*). Average SR 95.75%

The results of the research on the survival rate (SR) of swordtail broodstock during the research can be seen in the histogram percentage graph (%) in Figure 1 as followed:

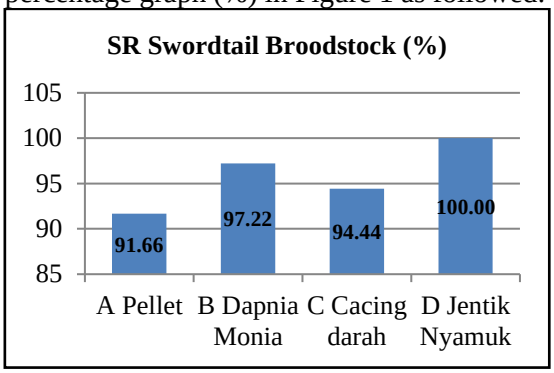

Figure 1.Histogram of Survival Rate of the Swordtail Broodstock

The results of the research from the illustration in Figure 1 show that the highest survival of swordtail in treatment D was fed with mosquito larvae (*Culex*) with SR 36 (100%) followed by treatment B was given water flea feed (Daphnia/Moina) SR 35 tail (97,22 %), treatment C was given blood worm feed (SR 35 blood worms) (94.44%), and the lowest in treatment A was given commercial pellet feed with SR level 33 tails (91.66%). The average SR of each treatment was 95.75%.

Observation of Broodstock's CBR

During the research, it was carried out to treat it with different feeds. Treatment A research was fed with commercial pellet feed, treatment B was fed with water fleas (Daphnia Moina), treatment C was given blood worm feed and treatment D was fed with mosquito larvae (*Culex*). Data on the results of the spawning rate of the plati broodstock were presented in Table 2.

Table 2 showed the highest birth rate of swordtail tillers produced in treatment D fed with mosquito larvae with a birth rate of 424 tails followed by treatment B fed with water fleas (Daphnia Moina) with 375 chicks, followed by treatment C with blood worms. (Blood worm) with the number of tillers 351 and the lowest in treatment A were given commercial pellet feed with a birth rate of 306 fish. The results of the research on the birth rate of the broodstock swordtail during the research can be seen in the histogram in Figure 2 as followed:

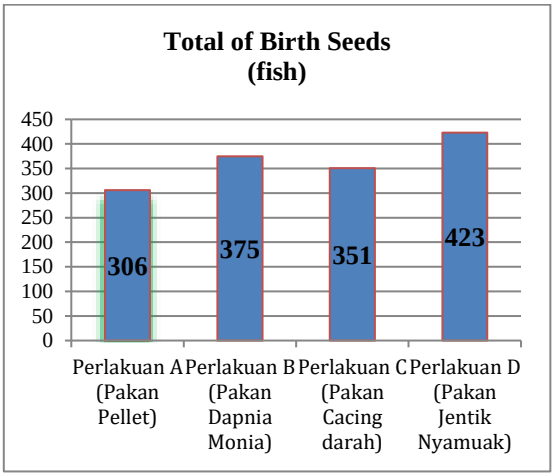

Figure 2. Histograms of the birth rate of the swordtail broodstock during the research

The illustration in the diagram of the birth rate of swordtail broodstock during the research of natural food (Daphnia / Moina feed, blood worms and mosquito larvae) produced more tillers compared to pellet treatment.

Table 2. Data on Spawning Results of the Swordtail Broodstock's Birth Rate

Feed Treatment	Reply	(fish)		
		Female	Male	Seeds
Nanolis	1	9	2	98
Pellet	2	9	2	105
(A)	3	9	2	103
Total		27	6	306
Average				102
Daphnia	1	9	3	126
/Moina	2	9	2	123
(B)	3	9	3	126
Total		27	8	375
Average				125
Blood	1	9	2	117
worms	2	9	3	115
(C)	3	9	3	119
Total		27	6	351
Average				117
Mosquito	1	9	3	141
larvae	2	9	3	143
(D)	3	9	3	139
Jumlah		27	9	423
Rata-rata				141

Source: Observations of birth rates during the research (2020).

The average birth rate of the broodstock swordtail during the research which was listed in Table 2 can be illustrated in the following diagram which was presented in Figure 3.

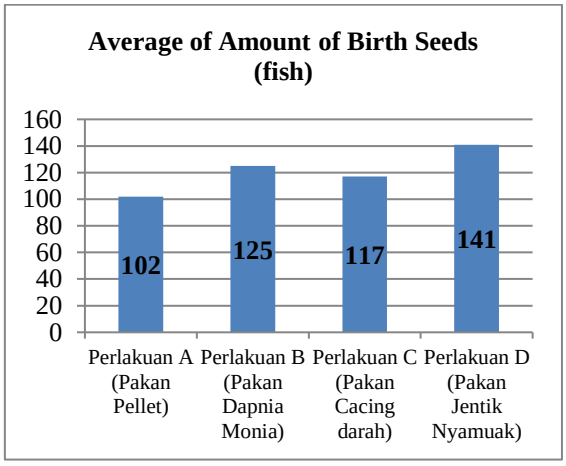

Figure 3.Histogram of Average Birth Rate of Swordtail Broods during the Research

Illustration Figure 3 in the diagram of the average birth rate of swordtail broods during the research, the highest average of tillers produced the highest in treatment D were fed with mosquito larvae (*Culex*) with a birth rate of 141 fish followed by treatment B given water flea feed (Daphnia/Moina) with 125 fish, followed by treatment C fed blood worms with 117 fish and the lowest in treatment A was given commercial pellet feed with a birth rate of 102 fish. The results showed that the natural feed given (Daphnia / Moina feed, blood worms and mosquito larvae) on average produced more tillers compared to the pellet treatment during this research.

Fish Health Check

Monitoring fish health with visual observation of its morphology and behavior, if it showed the abnormal symptoms, it indicated that the broodstock was sick, to determine the type of disease that attacks by diagnosing fish diseases that attack. During the research, there was no disease in the broodstock and seeds.

Management of Water Quality and Quantity

Water quality parameters measured by dissolved oxygen (DO), temperature, pH and hardness. The results of monitoring data on the average water quality during the research can be seen in Table 3 as followed:

Table 3. Data on Average Water Quality during the Research

Parameter	Time	Treatment			
		A	B	C	D
DO (mg/l)	Morning	4	4	4	4
	Evening	4	4	4	4
Temperature	Morning	26	26	27	26
(°C)	Evening	26	27	27	26
pH	Morning	7	7	7	7

	Evening	8	8	8	7
Hardness	Morning	30	30	30	30
(mg/l)	Evening	30	30	30	30

Source: Results of water quality measurements during the research (2020)

The results of research on water quality monitoring by measuring the parameters of Dissolved Oxygen (DO), temperature and pH were then carried out by comparing the standard standards referring to SNI. 8112: 2015.

Production section of ornamental swordtail (*Xyphophorus* sp., Heckel 1848), the measurement results were still suitable for broodstock spawning.

Observations of the Passing Life of the Seed

Monitoring of swordtail seed survival until 21 days of age (D_{21}). During the maintenance, the seeds were fed according to the broodstock treatment of spawned swordtail. The results of the swordtail seed survival rate until the age of 21 days (D_{21}) were presented in Table 4.

Table 4. Survival Results for Swordtail Seeds Up to 21 Days (D_{21})

Feed Treatment	21 Day Old Seed (D_{21})			
	Harvest (fish)		Mortaliy	SR
	Early	End	(fish)	(%)
A	306	143	163	46.73
B	375	190	185	50.67
C	351	171	180	48.72
D	423	209	214	49.41
Total	1.445	713	742	

Source: Results of observation of the survival of swordtail broodstock during the research (2020)

Table 4 showed the initial population of stocking (the seeds harvested by the swordtail broodstock) during the research produced 1.445 fish while during 21 days of maintenance (D_{21}) the live population was 713 fish, thus the mortality rate (mortality) was 742 fish.

The results of the research, the percentage (%) survival rate (SR) of seeds during 21 days of maintenance (D21) can be seen in the histogram in Figure 4 as followed:

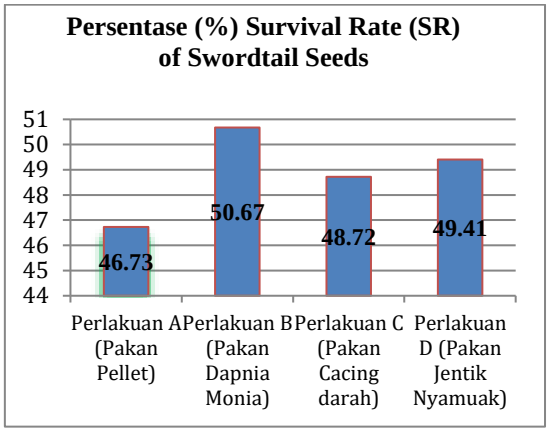

Figure 4.Histogram of the percentage of survival rate for swordtail seeds until 21 days of age.

Illustration Figure 4 showed the SR of the highest swordtail seed survival rate in treatment B given Daphnia/Moina feed with SR 50.67%, followed by treatment D given mosquito larva feed with SR 49.41%, then treatment C was given Blood worm feed with SR 48.72% and the lowest in treatment A was given commercial pellet feed with SR 46.73%.

Research Data Analysis

Examined the primary data collected, namely seed birth rate data in the SPSS Test Requirements for the Tukey Test (looking for the best treatment) the data must be tested for homogeneity and normality. Result of SPSS Statistical Test Calculation Terms of Tukey Test (looking for the best treatment) the data must be tested for homogenity and normaly.

Normality Test Results

The results of the normality test can be concluded from the normality test, namely the normality value of 0.2 or more than> 0.05 (data was normally distributed) so that it was continued to the homogeneity test.

Homogenity Test Results

The results of the normality test in Lampran 1 can be concluded that Annova 0.000 (P>0.005) was feasible for the homogenity test, then the results of the Homogenity Test Value were 0.465 or more than> 0.05 (Homogeneous data) then continue to the Tukey Test.

Tukey Test Results

Determined the best treatment in the research data distribution of Treatment A code of feed given Pellets; B Daphnia/Moina feed: C blood worm feed and treatment D Mosquito larvae feed. There were differences in yata between treatments and the most significant different treatment has the highest significant

value, namely treatment 4 (Mosquito Larva Feed). The best treatment in treatment 4. With a significant value of 0.14 (> 0.05) so that the treatment with code "4", namely mosquito larvae feed was the best treatment compared to other treatments. The results of the decision If F table <F count or sig> 0.05 then H_0 was rejected and H_1 was accepted, thus H_1: Natural feeding (alternative) affects the birth rate of swordtail broodstock.

Conclusions

The results of this research can be concluded as followed:

- The highest survival rate of swordtail was in treatment D (mosquito larvae feed) with SR 36 (100%) followed by treatment B (Daphnia/Moina feed) SR 35 fish (97.22%), treatment C (blood worm feed) SR 35 fish (94.44%), and the lowest was in treatment A (commercial pellet feed) SR level 33 fish (91.66%).
- The quality of water during the research, the water condition was suitable for the maintenance of broodstock, so that it supported the breeding to produce seeds.
- The swordtail broodstock that were spawned during the research were healthy because there were no diseases that attacked them
- Different feeding has an influence on the reproductive aspects of swordtail
- The highest average birth rate of swordtail broodstock produced in treatment D (mosquito larva feed) was 141 fish followed by treatment B (water flea feed) 125 fish, followed by treatment C for blood worm feed) 117 fish and the lowest was in treatment A (commercial pellet feed) with a birth rate of 102 fish.

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REFERENCES

Direktur Produksi, 2015. Kumpulan Standar Nasional Indonesia (SNI) Ikan Hias. Direktorat Produksi Direktorat Jendral Perikanan Budidaya. Jakarta.

Effendi, H. 2007. Biologi Perikanan. Kanisius. Yogyakarta.

Gusrina, 2015.Genetika dan Reproduksi Ikan.Deepublis. Yogyakarta

Kuncoro. E. B, 2011. Sukses Budidaya Ikan Hias Air Tawar.Lili publisher. Yogyakarta

Lingga P dan Susanto H. 2001.Ikan Hias Air Tawar. Penebar Swadaya. Jakarta.

Lesmana. D. S, 2007. Reproduksi dan Pembenihan Ikan Hias Air Tawar. Loka Riset Budidaya Ikan Hias Air Tawar. Departemen Kelautan dan Perikanan. Jakarta.

Lesmana. D. S dan Daelami. D, 2013.Panduan Lengkap Ikan Hias Air tawar Populer. Penebar Swadaya. Jakarta.