# PERFORMANCE OF TILAPIA, CARP AND MULLET UNDER POLYCULTURE CONDITION

FATMA ABDEL-FATTAH HAFEZ

*Central Laboratory for Aquaculture, Abbassa, Agricultural Research Centre, Dokki Giza, Egypt.*

(Manuscript received 27 February 1994)

## *Abstract*

In order to study the effect of growth response of different fish species to different protein levels, an experiment has been carried out using diets with different protein content(11%, 17% and 25%) for feeding cultured tilapia *S.aureus* , common carp *Cyprinus Carpio*, silver carp *Hypophthalmichthys molitrix* and mullet *Mugil cephalus* and *M. capito* in Abbassa farm Sharkia governorate belonging to Central Laboratory for Aquaculture. Twelve rectangle earthern ponds, of 0.25 feddan each were used representing four treatment -three replicates each.

The results showed that, differences in daily yield and total yield due to protein level were found to be significant ($p<0.01$). The resuts showed significant differences ($p<0.001$)among species in daily gain, daily yield and total yield . Correlation coefficients between productive traits ranged between (0.5 and 0.9).

Keywords: Polyculture, tilapia, common carp, silver carp, mullet, gain, yield and protein levels.

## INTRODUCTION

Fish in polyculture systems represent a possibility for increasing the total yield. This is especially with species differing in their feeding habits which are cultured to maximum use of all available natural as well as using suplementary feed in ponds. Choice of species and their densities will be determined accordingly. In order to achieve increased production, the species stocked must have different feeding habits and occupy different trophic niches in the pond. Common carp, tilapia,silver carp, grass carp and to a certain extent, mullet and bighead carp all differ in their feeding habits,and their culture in a pond increases total fish yield (Hepher and Pruginin 1981). In addition to the above consideration, other factors should be taken into account. Yashouv (1971) demonstrated that the yield of silver and common carp, cultured together in polyculture, is higher than that of either species alone. Asimilar effect has been seen when culturing common carp and tilapia (Herper and Pruginin1981). In practice, one should take into account, not only production, but also market price of each of the fish produced and the potential income from the different possible combinations. Management considerations, such as possibility of intermadiate harvesting and the sizedifferences among species should be considered.

In this study, polyculture of tilapia, common and silver carp, and mullet were studied under different levels of protein in diets and rates of feeding.

## MATERIALS AND METHODS

This work was conducted at Abbassa farm located in Abbassa village, Abu-Hammad, Sharkia Governorate. The farm belongs to the Central Laboratory for Aquaculture, Agricultural Research Centre.Twelve rectangle earthen ponds, 0.25 feddan (Fed) each, were used. Each pond, before being used, was drained and left to complete dryness, low spots were treated with calcium carbonate to kill any wild fish, larvae as well as their eggs. Great care was undertaken to screen the water inlets and outlets for each pond to prevent the entrance of wild fish, their eggs and larvae. Three diets with different protein contents (11%, 17% and 25%) were used for feeding cultured tilapia, *S. aureus,* common carp, *Cyprinus carpio,* silver carp,

*Hypophthamichthys molitrix* and mullet *Mugil cephlus* and *M. capito.*

All species were stocked during August 1992 together in each pond as a polyculture system. Number of fingerlings stocked in each pond were 500, 100, 75, and 250 for tilapia, common carp, silver carp and mullet, respectively. Fish were fed 3% of their body weight once per day. The diet of 17% protein was tested at two feeding rates, i.e. 3% and 6% of body weight of the fish. No feeding was applied in ponds during cold weather (winter season). At the end of the growing season (September 1993), ponds were drained and fish were harvested by seining. Fish to the three species harvested from each pond were separated and weighed.

Statistical analysis of the data collected was carried out by applying the computer program described by Harvey (1987). The pooled data of the four species tilapia, common carp, silver carp and mullet, for the variable of daily gain, daily yield and total yield were analysed using the following fixed linear regression model:

$$Yijk = M + Si + Pij + BK + (SB)\,ik + eijkl$$

where:

Yijk = observetion on the ijk fish;

M = overall mean, common element to all observations;

Bk = fixed effect of kth species;

Si = fixed effect of ith protein level;

Pij = fixed effect of jth pond nested within ith protein level;

(SB) ik= interaction between the effect of ith protein levels and the effect of kth species and

eijkl =a random deviation of lth fish, assumed to be independently and randomly distributed $(0,0\ -^{2})$.

Henderson's method 3 (1977) was utilized to estimate the variance components for the effects of protein levels, fish species, interaction between species and protein levels and remainder.

## RESULTS AND DISCUSSION

The mean and standerd errors of the productive traits (daily gain, daily yield) of tilapia, common and silver carp, and mullet fish, as well as total yield per pond at the end of the growing season (harvest time) are given in Table 1. Average daily gains were 0.4, 1.9, 3.7 and 0.6 grams for tilapia, common carp, silver carp and mullet, respectively. These observations may suggest highest daily gain for silver carp fish than either common carp or mullet. The lowest daily gain shown by tilapia fish may be due to that, tilapia started to reproduce when they became only few months old and have uncontrolled spawing in ponds.

Average daily yields per kilogramme was 0.2 kg / pond for common carp and silver carp, for tilapia and mullet, 0.1 kg / pond (Table 1). Data in Table 1 indicate that, average total yield of tilapia , common carp, silver carp and mullet were 40.4, 49.7, 60.8 and 32.8, respectively. This may confirm that fish of silver carp show the highest daily gain and total yield.

When analysing data of the productive traits of each species, the results showed significant differences ($P<0.001$) in daily gain, daily yield and total yield (Table 2) among the treatment groups. Differences in daily gain due to protein level were generally in favour of the lowest level (11% protein). The same picture was generally shown for total yield (Table 2). Average daily yield was the same at 11%, 17% and 25% protein content and when fed 3% of body weight (Table 2). The lowest productive traits was observed at 17% protein and fed 6% of the body weight (Table 1). In this respect,Lovell (1977) noted that culture species like tilapia, milkfish and silver carp are capable of making excellent gains on natural pond productivity. The same author added that, pond organisms can be an important source of the major nutrients (protein and energy). The effect of protein rate started to be important only after the amount of natural food available became lower. Fagbenro *et al.* (1992) noted that, protein efficiency ratio decreased with increasing dietary protein level and the feed conversion ratios were not significantly different. This agrees with the observed data.

Least-squares analysis of variance (Table 2) indicate that, differences between protein levels have significant ($P<0.01$) effect on daily yield and totat yield, and have no significant effect on daily gain. Differences between protein levels were not significant (Table 2). These findings are expected because of the differences among earthen ponds in types of natural food resources and other environmental conditions which vary from one pond to another . In this respect, Hepher and Prugi-

nin (1981) noted that, production of fish was affected by several factors such as stocking rate, size of fish stocked, and amount of available natural and artificial food in pond system. They added that, these may emphasize that production traits of fish studied are affected by a number of factors interact with the protein level in fish pond system. Also, this observation may be attributed to the low available space, dissolved oxygen and food in ponds environment that exist under the high rate of feeding. Lovell (1977) noted that, fish low in food chain have good growth and production based on natural food organisms.

Correlation coefficients between both stocked fish and harvested fish for the three productive traits (daily gain, daily yield and total yield) are presented in Table 3. The values of these correlation coefficients indicate that the highest correlation coefficient ($r \simeq 0.7 - 0.9$) were those between stocked and harvest weight and daily gain. Similar values of correlation coefficient were observed between weight at harvest and daily gain, daily yield and total yield . Similar results were obtained between daily gain and both daily yield and total yield (Table 3). The lowest coefficient of correlation was observed between weight of stocked fish and total yield (Table 3). It may be concluded that, there are high correlation coefficients between productive traits studied. The observations also showed poor association of stocked weight with productive traits. This could be attributed to that fish growth and production are affected by several factors more than fish size.

Table 1. Least-squares means and standard errors for the productive traits of the different fish species.

| Indepndent Variable | N | Wt. stocked (g) mean ± SE | Wt.Harvested (g) mean ± SE | Daily gain (g) mean ± SE | Daily yield (Kg) mean ± SE | Total yield (Kg) mean ± SE |
|---|---|---|---|---|---|---|
| Species | | | | | | |
| Tilapia | 12 | 3.5±0.2 | 129.0±83.1 | 0.4±0.3 | 0.1±0.02 | 40.4±4.4 |
| Comman carp | 12 | 4.1±0.2 | 646.3±83.1 | 1.9±0.3 | 0.2±0.02 | 49.7±4.4 |
| Silver carp | 12 | 11.0±0.2 | 1231.5±83.1 | 3.7±0.3 | 0.2±0.02 | 60.8±4.4 |
| Mullet | 12 | 0.7±0.2 | 179.2±83.1 | 0.6±0.3 | 0.1±0.02 | 32.8±4.4 |
| Protein level | | | | | | |
| 1st Diet 11% | 12 | 4.5±0.2 | 679.3±83.1 | 2.3±0.3 | 0.2±0.02 | 53.2±4.4 |
| 2 nd Diet 17% | 12 | 4.6±0.2 | 496.7±83.1 | 1.6±0.3 | 0.2±0.02 | 46.9±4.4 |
| 3rd Diet 17% | 12 | 4.8±0.2 | 432.3±83.1 | 1.3±0.3 | 0.1±0.02 | 32.8±4.4 |
| 4th Diet 25% | 12 | 5.4±0.2 | 577.8±83.1 | 1.6±0.3 | 0.2±0.02 | 50.9±4.4 |

1st Diet 11% ( 3% of body weight)
2 nd Diet 17% ( 3% of body weight)
3rd Diet 17% ( 6% of body weight)
4th Diet 25% ( 3% of body weight)

Table 2. Least-squares analysis of variance for factors effecting productive traits of the different fish species.

| Source of variation | DF | Stocked weight MS | F.ratio | Harvested weight MS | F.ratio | Daily gain MS | F.ratio | Daily yield MS | F.ratio | Total yield MS | F.ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total reduction | 24 | 29.9 | *** 85.6 | 467094.4 | ** 5.60 | 3.80 | *** 3.80 | 0.00 | * 2.40 | 487.60 | * 2.10 |
| MU - YM | 1 | 0.0 | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Speceis | 3 | 229.8 | *** 658.5 | 315326.9 | *** 31.10 | 28.30 | *** 25.30 | 0.03 | *** 9.80 | 1755.60 | *** 7.60 |
| Protein level (PL) | 3 | 2.1 | ** 5.9 | 136639.7 | ns 1.60 | 1.90 | ns 1.70 | 0.02 | ** 5.70 | 997.60 | ** 4.30 |
| Ponds in 1st PL | 2 | 0.0 | 0.0 | 147.2 | ns 0.00 | 0.0 | ns 0.00 | 0.00 | ns 0.30 | 97.70 | ns 0.40 |
| Ponds in 2nd PL | 2 | 1.4 | * 4.0 | 4082.3 | ns 0.05 | 0.20 | ns 0.20 | 0.00 | ns 0.20 | 67.40 | ns 0.30 |
| Ponds in 3rd PL | 2 | 0.0 | 0.0 | 394780.7 | ns 4.80 | 0.90 | ns 0.80 | 0.00 | ns 0.80 | 987.40 | ns 4.20 |
| Ponds in 4th PL | 2 | 0.0 | 0.0 | 578.1 | * 0.01 | 0.00 | ns 0.00 | 0.00 | ns 0.10 | 34.40 | ns 0.10 |
| S X PL | 9 | 2.1 | *** 5.9 | 60001.9 | ns 0.70 | 1.10 | ns 0.90 | 0.00 | ns 1.10 | 118.90 | ns 0.50 |
| Remainder | 24 | 0.3 | | 828863.3 | | 1.11 | | 0.00 | | 232.20 | |

*** P<0.001 , **P<0.001 , **P<0.05, n>0.05

Table 3. Correlation coefficients among the productive traits of the different fish species.

| | Wt. stocked | Wt. harvested | Daily gain | Daily Yield | Total Yield |
|---|---|---|---|---|---|
| Wt. stocked | | | | | |
| Wt. harvested | 0.8 | | | | |
| Daily gain | 0.7 | 0.9 | | | |
| Daily Yield | 0.6 | 0.8 | 0.8 | | |
| Total Yield | 0.5 | 0.7 | 0.7 | | 0.8 |

Table 4. The interaction between the effect of ith species and kth protein level on the productive traits (daily gain, daily yield and total yield).

| Trait | Stoked wtXPL mean ± SE (g) | Harvested wtXPL mean ± SE (g) | Daily gain X PL mean ± SE (g) | Daily yield X PL mean ± SE (g) | Total yiel mean : (g) |
|---|---|---|---|---|---|
| Tilapia XPL1 | 3.5±0.3 | 134.3±166.2 | 0.4±0.6 | 0.1±0.03 | 38.8±8 |
| Tilapia XPL2 | 3.5±0.3 | 134.3±166.2 | 0.4±0.6 | 0.1±0.03 | 43.3±8 |
| Tilapia XPL3 | 3.5±0.3 | 107.7±166.2 | 0.3±0.6 | 0.1±0.03 | 34.3±8 |
| Tilapia XPL4 | 3.5±0.3 | 140.0±166.2 | 0.4±0.6 | 0.2±0.03 | 45.2±8 |
| Common C.X PL1 | 3.0±0.3 | 690.7±166.2 | 2.3±0.6 | 0.2±0.03 | 59.6±8 |
| Common C.X PL2 | 3.0±0.3 | 603.7±166.2 | 1.9±0.6 | 0.1±0.03 | 47.8±8 |
| Common C.X PL3 | 3.0±0.3 | 562.0±166.2 | 1.4±0.6 | 0.1±0.03 | 36.4±8 |
| Common C.X PL4 | 3.0±0.3 | 729.0±166.2 | 2.4±0.6 | 0.2±0.03 | 55.0±8 |
| Silver C.X PL1 | 1.0±0.3 | 1654.7±166.2 | 5.5±0.6 | 0.3±0.03 | 68.0±8 |
| Silver C.X PL 2 | 1.0±0.3 | 1059.3±166.2 | 3.5±0.6 | 0.2±0.03 | 64.7±8 |
| Silver C.X PL 3 | 1.0±0.3 | 948.0±166.2 | 3.1±0.6 | 0.1±0.03 | 38.8±8 |
| Silver C.X PL 4 | 1.0±0.3 | 1264±166.2 | 2.8±0.6 | 0.2±0.03 | 71.7±8 |
| Mullet X PL 1 | 0.7±0.3 | 237.7±166.2 | 0.8±0.6 | 0.2±0.03 | 46.4±8 |
| Mullet X PL 2 | 0.7±0.3 | 189.7±166.2 | 0.6±0.6 | 0.1±0.03 | 31.5±8 |
| Mullet X PL 3 | 0.7±0.3 | 111.3±166.2 | 0.4±0.6 | 0.1±0.03 | 21.8±8 |
| Mullet X PL 4 | 0.7±0.3 | 178.0±166.2 | 0.6±0.6 | 0.1±0.03 | 31.5±8 |

PL = Protien level

C. = Carp

## REFERENCES

1. Fagbenro, O.A. , A.M. Balogun, and C.N. Anyanwu.1992. Optimal dietary protein level for Heterobranchus bidorsalis fingerlings fed compound diets. J. Aqua.Bamideh, 44, (3): 87-92.
2. Harvey, W.R.1987. User's guide for LSWLMW. Mixed model Least- squares and maximum Likelihood computer program. PC-1 Version. Ohio State University, Columbus, USA.
3. Henderson, C.R. 1977. Best Linear Unbiased Prediction of Breeding values not in the model for Records. J. Dairy Sci., 60:783-787.
4. Hepher, B. and Y. Pruginin. 1981. Commercial Fish Farming. A Wiley-Intersciences Publication, USA.
5. Lovell,T. 1977. Estimate need on contribution of pond organisms fish feed. Commercial Fish Farmers and Aquaculture News, July, Vol. 3, No. 5.
6. Yashouv, E. 1971. Interaction between the common carp (Cyprinus carpio) and the silver carp (Hypophthalmichthys moliteix) in fish ponds. Bamidgeh, 23 (3): 85-92.

# أداء أسماك البلطى والمبروك والبورى فى نظام الإستزراع المختلط

فاطمة عبد الفتاح حافظ

المعمل المركزى لبحوث الأسماك بالعباسة – مركز البحوث الزراعية الدقى – الجيزة – مصر.

أجريت تجربة لإختبار تأثير معدلات نسبة البروتين فى العليقة على نمو أسماك البلطى والمبروك والبورى فى نظام الإستزراع المختلط. إستعملت علائق تحتوى على ١١ ، ١٧ ، ٢٥ ٪ بروتين فى العليقة وتم اختبار هذه المعاملات فى أحواض ترابية مساحة ربع فدان تابعة للمعمل المركزى لبحوث الأسماك بالعباسة بمركز البحوث الزراعية. وقد أسفرت النتائج عن وجود فرق معنوى بين الأنواع والمعاملات لكل من القياسات المستعملة وهى متوسط الوزن اليومى والإنتاج الكلى لأنواع الأسماك وبين المعاملات بالنسبة لمستويات البروتين فى العليقة ووجود إرتباط بين القياسات الإنتاجية المختلفة (٠,٠٥ – ٠,٠٩).