ASSESSMENT OF THE FERTILIZATION REQUIREMENTS OF
THE CHINESE CARP FRY, SILVER CARP
(Hypophthalmichthys molitrix); BIG HEAD (Aristichthys
nobilis); AND GRASS CARP (Ctenopharyngodon idellus),
DURING THE NURSING PHASE

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ABSTRACT

Two different manure application regimes were applied in two groups of
ponds for nursing of post yolk sac Chinese carp fry, big head (Aristichthys nobilis)
silver carp (Hypophthalmichthys molitrix) and grass carp (Ctenopharyngodon idellus)
Five days before stocking the ponds with fry, basic manure application was done
using pure chicken manure at the ratio of 0.5 kg/m³ of water for ponds of the first
group and 0.25 kg/m³ of water for ponds of the second group to stimulate the
development of the natural food. The ponds were stocked at a stocking density of 20, 10
and 5 fry/m³ for the three species, respectively. After stocking, the manure
application amounts were 0.2 kg/m³ and 0.1 kg/m³ of water every day for the first and
second group, respectively. Peanut cake was administered for feeding at a ratio of 3
g/1000 fry per day. The duration of the nursing period was 12 days. During the
experimental run, growth of fry of the three species in all pondS was monitored and
the density of plankton/liter and the organic matter contents were estimated every
other day. Upon termination of the fry nursing period, average final weight of the fry
and survival rate were estimated. The initial dominant species of phytoplankton
emerging initially after fertilization had intimate relation to the amount of manure.
Some species of green algae Chlorophyta such as Scenedesmus, Pediastrum and
Ankistrodesmus sp. and some species of blue green algae Cyanophyta such as
Oscillatoria and Anabaena sp. developed vigorously when a larger quantity of manure
was applied in the first group of ponds. While with less manure in the second group
of ponds, many of the diatoms of class Bacillariophyta were found dominant such as
Navicula and Cyclotella sp. When low manure application rate was adopted the
surviving number of big head and silver carp was low (70.2 and 75.1%, respectively)
and that of grass carp was high (87.5%). When high manure was applied survival rate
of big head and silver carp increased significantly (89.3 and 82.7%, respectively) while
that of grass carp significantly decreased (72.4%). Also, growth performance of big
head and silver carp fry was poor and that of grass carp was high under low
fertilization conditions compared to the high fertilization regime. Fry of big head, silver
carp and grass carp reached 67.1, 105.1 and 85.9 times of their initial body weight,
respectively. On the contrary, fry of big head and silver carp grew better and gained
significantly larger mean body weight/fry (by 82.6 and 162 times of the initial body
weight, respectively) under high manure application conditions. While grass carp fry
did not grow as large as the other two species and gained smaller mean body
weight/fry (by 55.1 times of the initial body weight). It could be concluded, from the
present study, that nursing of big head and silver carp fry requires more fertile water
than that required for grass carp fry. Subsequently, monoculture system is preferable
for the fry during the nursing stage.

Keyword: Nursing, Grass carp, Silver carp, Big head carp, Polyculture, Fertilization
requirements
INTRODUCTION

Application of manure is one of the effective measures to raise the output and survival of fish. It helps to culture various kinds of plankton in water, which serves as direct or indirect feeds for fry. Fry can grow faster at higher survival rate because of the numerous food organisms reproduced. Few researches have been conducted in this regard. Green and Smitherman (1984) carried out an experiment to compare the relative growth, survival and harvestability of bighead carp, silver carp and their reciprocal hybrids during the primary rearing phase in ponds and concrete tanks. Saha et al. (1989) studied the effect of different fertilizers on the growth and survival of silver carp spawn in nursery ponds. Kirkagac (2003) studied the gut contents of grass carp during the nursing phase in earthen ponds. Kumar et al. (2004) used green manure and pig manure to fertilize an earthen pond for nursing of silver carp. They monitored the hydro-biological parameters of water before and after fertilization to verify the essential requirements of natural food for growth and survival of the early fry. Shireman and Smith (1983) studied some biological data on grass carp Ctenopharyngodon idella. Jhingran and Pullin (1985) published a hatchery manual for the common, Chinese and Indian carps. Opsuszynski and Shiremen (1995) reared the herbivorous fish grass carp for weed management. Bromage and Roberts (1995) studied broodstock management and egg and larval quality of Chinese carps.

The aim of this work was to evaluate the fertilization requirements of the Chinese carp fry during the nursing phase.

MATERIALS AND METHODS

Six concrete ponds with an area of 25 m² each, at the Central Laboratory for Aquaculture Research, were filled with fresh water. The water column was maintained at 1 meter level. The ponds were supplied with aeration pipes. The ponds were randomly assigned into two groups representing two treatments (three replicates each). Two different manure application regimes were applied in the two groups for nursing of Chinese carp fry. Five days before stocking the ponds with fry, basic manure application was done using pure chicken manure, from Wady El-Mollak; Sharkia, at the ratio of 0.5 kg/m³ of water for ponds of the first group and 0.25 kg/m³ of water for ponds of the second group to stimulate the development of the natural food. The manure was applied directly inside the ponds and undecayed bits of the left-over were removed before the fry were stocked. Ponds of the two groups were stocked in polyculture system with three species of post yolksac larvae of Chinese carp, big head carp (Aristichthys nobilis); silver carp (Hypophthalmichthys molitrix) and grass carp (Ctenopharyngodon idella), at a stocking density of 20, 10 and 5 fry/m³ for the three species, respectively. The postsac larvae were purchased from El-Abbassa Hatchery. After stocking, the regular manure application was adopted every day at a rate of 0.2 kg/m³ and 0.1 kg/m³ of water for the first and second group, respectively. Soy bean cake was administered for feeding at a ratio of 3 g/1000 fry per day. The duration of the nursing period was 12 days.
During the experimental run, growth of fry of the three species in all pond was monitored every other day, the density of plankton/liter and the organic matter content were estimated according to Boyd and Tucker (1992).

Upon termination of the fry nursing period, average final weight of the fry and survival rate were estimated. Analysis of variance and Duncan (1955)'s multiple range test were used to detect differences in mean value of the measurements due to treatment effects.

RESULTS

Organic matter content:

As illustrated in Figure (1), the organic matter content in ponds of the higher fertilization rate was 41.1 ± 4 mg/l on the first day of the nursing period just before fry stocking. It dropped down rapidly after fry were stocked and went down by 20.2 ± 5.3 mg/l in four days. At the end of the experimental period, the organic matter content reached 6 ± 2 mg/l. While in ponds of the lower fertilization regime, as shown in Figure (2), the organic matter content was 20 ± 2.6 mg/l before stocking and decreased to 12 ± 3 mg/l on the fifth day after stocking and 3.3 ± 1.7 mg/l on the last day before harvesting. Generally, the mean value of organic matter content during the whole nursing period with applying the higher manure application rate (16.6 ± 2.3 mg/l) was significantly (p< 0.05) higher than that with applying the lower manure application rate (10.9 ± 1.7 mg/l).

Figure (1): Organic matter content (mg/l) during the fry nursing period in the three ponds of high manure application rate (1st treatment).

Hydro-biological features:

Phytoplankton:

The phytoplankton communities in ponds of the two systems were represented by three groups, Chlorophyta (green algae), Bacillariophyta (diatoms) and Cyanophyta (blue-green algae). However, the dominant groups developed in ponds of the first fertilization regime (higher manure application) were Chlorophyta and Cyanophyta and the dominant genera sprang up in ponds of the second fertilization regime (lower manure application) was Bacillariophyta. Among the organisms of Chlorophyta group, Spirogyra,
Protococcus, Pediastrum, Crucigenia, Closterium and Ankistrodiscus were recorded as dominant. Phylum Bacillariophyta constituted six major genera: Navicula, Cyclotella, Stephnodiscus, Flagillaria, Synedra and Diatoma. Nostoc, Oscillatoria and Anabaena were found dominant components in third group (Cyanophyta).

Figure (2): Organic matter content mg./l during the fry nursing period in the three ponds of low manure application rate (2nd treatment).

As shown in Figures (3) and (4), there was a significant ($p< 0.05$) increase in the average phytoplankton number per liter in ponds of the first regime than that in ponds of the second one during the entire fry nursing period, being $903 \pm 90.3$ org./l and $557 \pm 72.4$ org./l, respectively.

Figure (3): Fluctuations of phytoplankton density (org./l) during the fry nursing period in ponds of high manure application rate.

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Figure (4): Fluctuations of phytoplankton density (org./l) during the fry nursing period in ponds of low manure application rate.

Zooplankton:

As indicated in Table (1) two genera, Rotifera and Crustacea represented the zooplankton community in both systems. Crustacea constituted Daphnia (Cladocera); Diaptomus, Limnocalanus and Nauplius (Copepoda) and Eubranchipus (Ostracoda). Average number of zooplankton per liter was significantly (p< 0.05) higher in ponds of the increased organic matter than in ponds of the decreased organic matter, being 890 ± 80.3 vs. 651 ± 98.2 org./l, in the whole nursing cycle.

Survival rate:

At the end of the experiment, the average survival rate of big head, silver carp and grass carp in the highly fertilized ponds was 89.3 ± 2.7, 82.7 ± 2.4 and 72.4 ± 2.8%, for the three species respectively (Figure 5). While the average survival rate of the three fry species recorded 70.2 ± 4.3, 75.1 ± 3.2 and 87.5 ± 2.7%, respectively, in the less fertilized ponds.

Growth performance:

In the period of fry culture, the growth of the three fry species in both systems was measured. As indicated in Figure (6), the initial weight of big head, silver carp and grass carp fry was 3 ± 0.3, 3 ± 0.4 & 2.17 ± 0.2 mg/fry with an average body length of 8.3 ± 02, 8.2 ± 0.2 and 6.5 ± 0.4 mm, respectively. In ponds of the higher fertilization rate, fry of the three species reached 21.8 ± 0.9, 23.5 ± 1.1 and 13.9 ± 0.7 mm body length with an average body weight of 247.8 ± 3.3, 486 ± 8 & 118 ± 8.2 mg/fry, respectively. While in ponds of the lower fertilization regime, the fry attained 201.4 ± 4.9, 315.4 ± 9.7 & 141 ± 6.2 mg/fry body weight and the average length reached 17.8 ± 0.7, 15.5 ± 0.9 & 16.9 ± 0.5 mm, respectively (Figure 7).
The table below shows the fluctuations of zooplankton density (org/L) during the fry nursing period in ponds of low and high manure application rate.

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td>173±</td>
<td>180±</td>
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<td>92±</td>
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<td>20±5</td>
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<td>1634±</td>
<td>1375±</td>
<td>770±</td>
<td>770±</td>
<td>652±</td>
<td>376±</td>
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<td>38±</td>
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<td>150±</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

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Figure (5): Survival of B. h., S. c. & G. c. in ponds of low and high fertilization rate.

Table (2): Physico-chemical properties of water in ponds of the two treatments during the nursing period.

<table>
<thead>
<tr>
<th>Property</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
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<td>Temperature (°C)</td>
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<td>25</td>
</tr>
<tr>
<td>pH</td>
<td>8</td>
<td>8.5</td>
</tr>
<tr>
<td>Dissolved oxygen (mg/l)</td>
<td>5.5</td>
<td>6.1</td>
</tr>
<tr>
<td>Alkalinity (ppm)</td>
<td>200</td>
<td>340</td>
</tr>
<tr>
<td>Ammonia NH₃ (ppm)</td>
<td>0.2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Figure (6): Growth of fry of B.H., S.c. and G.c. after stocking in fertile ponds.
DISCUSSION

It was obvious in the present study that the initial dominant species of phytoplankton emerging initially after fertilization had intimate relation to the amount of manure. Some species of green algae Chlorophyta such as Scenedesmus, Pediastrum and Ankistrodesmus sp. and some species of blue green algae Cyanophyta such as Oscillatoria and Anabaena sp. developed vigorously when a larger quantity of manure was applied in the first group of ponds. While with less manure in the second group of ponds, many of the diatoms of class Bacillariophyta were found dominant such as Navicula and Cyclotella sp.

In both systems, two genera of Rotifera and Crustacea represented the zooplankton community. Crustacea constituted Daphnia (Cladocera); Diaptomus, Limnocalanus and Nauplius (Copepoda) and Eubranchipus (Ostracoda). Average number of zooplankton per liter was significantly (p<0.05) higher, in ponds of the increased organic matter than in ponds of the decreased organic matter being 890 ± 80.3 vs. 651 ± 98.2 org./l, in the whole nursing cycle.

The present study indicated also that ponds supplied with larger quantity of poultry manure maintained significantly larger quantity of plankton and significantly higher values of organic matter content than those ponds of lower manure application throughout the whole period of fry nursing.

The content of organic matter was significantly higher in ponds of the intensive fertilization system than in the other slightly fertilized ponds, on the first day of nursing. It dropped down rapidly after fry were stocked in ponds of
both systems. But the average value of organic matter content during the entire nursing period was generally higher in the former system than in the later.

Two days after stocking, grass carp grew most rapidly in ponds of low fertility, exceeding the other two species in body length, but after the 10th days, surpassed by big head. Nevertheless, after two more days (at the end of the experiment) differences in the mean body weight/fry were not significantly different among the three fry species. From the first day on, in ponds of high fertility, big head grew faster than silver carp and grass carp, but after the 10th day it was surpassed by silver carp. Grass carp dropped far behind as compared with silver carp and big head. Consequently, the present data suggested that low fertile water was more preferable for growth of grass carp than high fertile water. While more fertile water was more appropriate for growth of silver carp and big head than low fertile water.

Although oxygen content was sufficient for normal growth in both systems, as represented in table (2), the changes of water quality due to changes in the fertilization regime influenced the survival rate and growth performance of fry. There were significant differences among means of survival rate and body weight/fry of the three fry species under two different fertilization regimes within 12 days nursing period. When low manure application rate was adopted the surviving number of big head and silver carp was low (70.2 and 75.1%, respectively) and that of grass carp was high (87.5%). When high rate of manure was applied survival rate of big head and silver carp increased significantly (89.3 and 82.7%, respectively) while that of grass carp significantly decreased (72.4%).

Also, growth performance of big head and silver carp fry was poor and that of grass carp was high under low fertilization conditions compared to high fertilization regime. Fry of big head, silver carp and grass carp reached 67.1, 105.1 and 65.9 times of their initial body weight, respectively.

On the contrary, fry of big head and silver carp grew better and gained significantly larger mean body weight/fry (by 82.6 and 162 times of the initial body weight, respectively) under high manure application conditions. While grass carp fry did not grow as large as the other two species and gained smaller mean body weight/fry (by 55.1 times of the initial body weight). This may be attributed to the favorability and selectivity of each of the three Chinese carp fry to specific natural food items that could be dominant and available when different amounts of manure were applied.

Comparing the present study with others is difficult because of the different experimental condition. For example, growth, survival and harvestability of a different polyculture combination of only two Chinese carp fry, big head and silver carp, and their reciprocal hybrids were studied by Green and Smitherman (1984) in a different primary rearing period in ponds and concrete tanks stocked at a different stocking density from that of the present study. Although Kumar et al. (2004) used different manure application for fertilization of earthen ponds for nursery rearing of 4 days-age silver carp; however, blooming of large zooplankton (cladocerans and copepods) was also observed after fertilization which was essential for the
growth of silver carp fry. This result is in partial agreement with the present observation concerning silver carp. The result of gut content examination of grass carp during the nursery period made by Kirkagac (2003) supported the opinion that grass carp fry require low fertile water during the nursery rearing period. At the first week, animal material represented 74% of the gut contents. From the second week onward, plant material were higher.

It could be concluded from the present study that nursing of big head and silver carp fry requires more fertile water than that is required for grass carp fry. Subsequently, monoculture system is preferable for the fry during the nursing stage.

REFERENCES


تقييم الاحتياجات التسويقية لزراعة المبروك الصيني الفضي وكبير الرأس
جمال عبد الناصر محمد وأحمد عبد الفتاح أحمد محمود
1- قسم التفريخ وفسيولوجيا الأمساك
2- قسم إنتاج ونظم الاستزراع السمكي
العمل المركزي لبحث الثروة السمكية

تم اختيار معدلين مختلفين للتسويق لدراسة الاحتياجات التسويقية لمختلف أنواع زراعة المبروك الصيني الفضي وكبير الرأس والحشائش أثناء فترة الحضانة التي استغرقت اثني عشر يوما بعد فترة انتقاص كيس السمح. استخدمت لهذه الدراسة مجموعتين من الأحوار الخرسانية كل مجموعة ثلاثة أحياء ، مصنفة لكل منها 25 م² كانت كثافة التحضين 20 التي للجر للليك المكب من المياه للأنواع الموجودة على التوالي. واستخدمت في المجموعة الأولى من الأحوار معدلات تسويقية عالية 6/5 كجم زرع دواجن/م² من المياه في التسويق الأساسي قبل التحضين بخمسة أيام، وفي التسويق الدوري 2 كجم/م² يوميا أما المجموعة الثانية من الأحوار فقد استخدمت فيها معدلات تسويقية منخفضة 2،5 كجم/م² التسويق الأساسي و0.1 كجم/م² التسويق الدوري. وتمت متابة معدلات النمو للحشائش وكثافة الأحوار في الثلاثة أشهر الأولى. وفي نهاية فترة التحضين تم قياس متوسطات أوزان الجسم لكل من الأنواع الثلاثة. ومن نتاية هذه الدراسة أتضح أن أوزان الأحوار النباتية التي سادت في المياه بعد التسويق ارتبطة بكمية التسويق، إذ ظهرت بشكل سائد بعض أنواع الطحالب الخضراء (الكلوروبايتات) مثل السينيديماس، والبليستيرام، والأكستروديماس، وبعض الطحالب الخضراء المزرقة (السيانوفين) مثل الأوسكيليكاروسيا، والأرانتيا في أعواصم الأحوار الأولي التي تم تسويقها بمعدلات تسويقية أعلى. بينما سادت أنواع أخرى من هذه الهايمات ك الديلميماس من رتبة (الباسيالبارفيتات) مثل النافيكريولا، والسابلولينلا عند استخدام معدلات تسويقية منخفضة في أعواصم الأحوار الثالثة. وذات معدلات الإحالة نمو كبير الرأس والفاضي منخفضة 5,1 و3% على التوالي. ثم تم التقاط صور المبروك وحشائش، حيث وصل متوسط وزن الزراعة 0.14 وزن 0.15 مرة من وزنها الأصلي على التوالي، وفي المقابل في أعواصم التسويق المرتفع كان أداء النمو عاليًا بالنسبة لكيه الرأس والفضي زيادة معنوية لتصبح 82.7 وزن 82.7% على التوالي، بينما قيلت بشكل معنوي بالنسبة لمبروك الحشائش 77% ، كذلك كان أداء النمو في كيير الرأس والفضي ضعيفا وفي مبروك الحشائش عاليا تحت ظروف التسويق المنخفضة حيث وصل متوسط وزن الزراعة 0.14 وزن 0.15 مرة من وزنها الأصلي على التوالي، وفي المقابل في أغواصم التسويق المرتفع كان أداء النمو عاليًا بالنسبة لكيه الرأس والفضي بنسبة 77% و 55,1 مرة من وزنها الأصلي على التوالي. وعلى ذلك يستطيع أن الرعاية المبكرة لزراعة المبروك كبير الرأس والمبروك الفضي تتطلب معدلات تسوية أعلى من التي تحتاجها زراعة مبروك الحشائش، وكذلك يفضل أن تكون الرعاية المبكرة لكل نوع على حدة لاختلاف الاحتياجات التسويقية لكل منها في هذه المرحلة.