J. Agric. Sci. Mansoura Univ., 31 (5): 2765 - 2775, 2006

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 yolksac 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/m^3 of water for ponds of the first group and 0.25 kg/m^3 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/m^3 for the three species, respectively. After stocking, the manure application amounts were 0.2 kg/m^3 and 0.1 kg/m^{3}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 Cyclotalla 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 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). 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 herbivourous 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 m^2 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/m^3 of water for ponds of the first group and 0.25 kg/m^3 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 idellus*), at a stocking density of 20 , 10 and 5 fry/m^3 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/m^3 and 0.1 $kg/m^3$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).

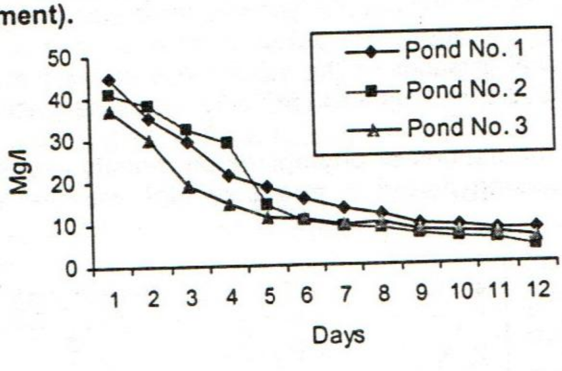
Upon termination of the fry nursing period, average final weight of the fry and survival rate were estimated. Analysis of variance and Duncan (1955)S multiple ringe test were used to detect differences in mean value of the measurements due to treatment effects.

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).

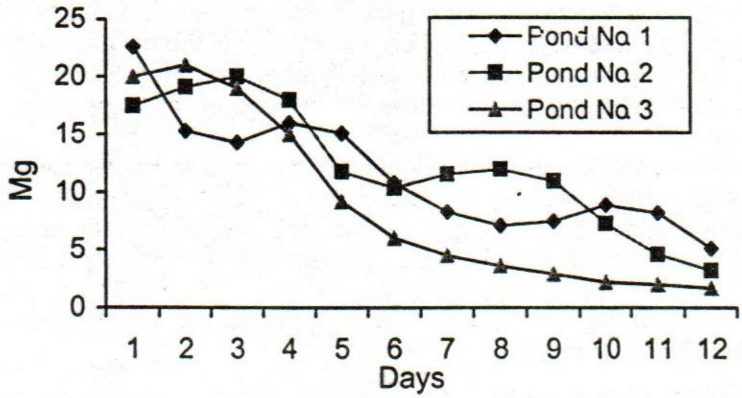


Hydro-biological features:

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 Ankistrodismus* were recorded as dominent. Phylum *Bacillariophyta* constituted six major genera: *Navicula, Cyclotalla, Stephnodiscus, Flagillaria, Synedra* and *Diatoma. Nostoc, Oscellatoria* 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 (2st 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 ± 90.3 org./l and 557 ± 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.

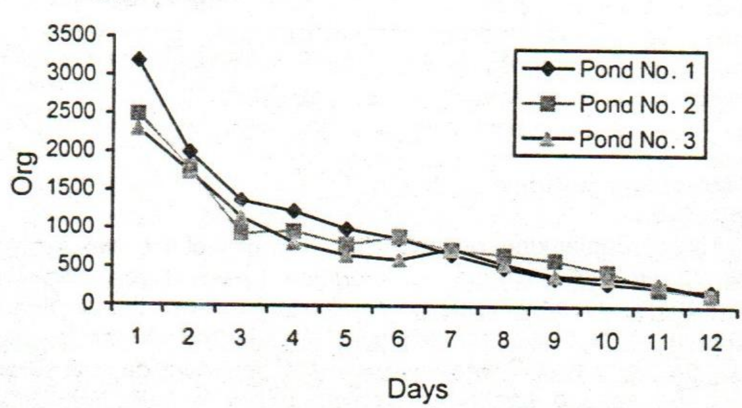
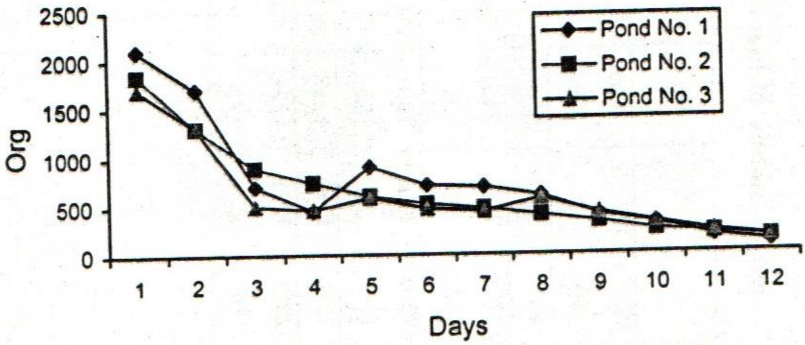


Figure (4): Fluctuations of phytoplankton density (org./l) during the fry nursing period in ponds of low manure application rate.



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).

Table (1): Fluctuations of zooplankton density (org./L) during the fry nursing period in ponds of low and high manure application rate.

Item	Day / Zoo.Org. / L	1	2	3	4	5	6	7	8	9	10	11	12
Ponds of high manure application	Rotifera	2000 ± 455	2030 ± 329	1600 ± 173	1300 ± 180	700 ± 105	600 ± 92	620 ± 121	350 ± 80	350 ± 78	200± 20	200± 40	150 ± 46
	Crustacea	100±20	90±20	84±20	75±16	70±10	50±10	32±9	26±6	20±5	15±6	10±4	6±2
	Total zooplankton	2100 ± 475	2120 ± 315	1684 ± 164	1375 ± 183	770± 101	650± 85	652± 120	376± 83	370± 80	215± 24	210± 38	156± 44
Ponds of low manure application	Rotifera	1700 ± 223	1550 ± 114	1100 ± 255	650± 210	300± 95	290± 72	270± 70	260± 70	210± 79	180± 66	150± 53	100± 20
	Crustacea	70±20	65±16	60±19	64±17	62±8	42±7	25±5	22±6	17±3	12±3	8±4	3±3
	Total zooplankton	1770 ± 236	1615 ± 127	1160 ± 270	714± 214	362± 99	332± 78	295± 73	282± 76	227± 82	192± 68	158± 57	103± 18

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

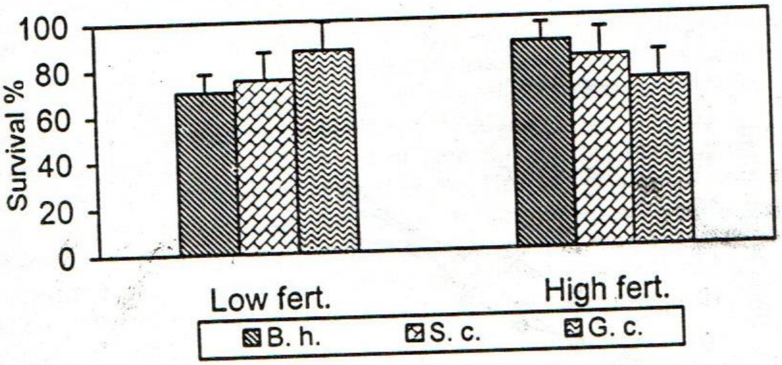


Table (2): Physico-chemical properties of water in ponds of the two treatments during the nursing period.

Temperature (^{o}C)	22 - 25
pH	8 – 8.5
Dissolved oxygen (mg/l)	5.5 – 6.1
Alkalinity (ppm)	200 - 340
Ammonia NH_3 (ppm)	0.2 – 0.5

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

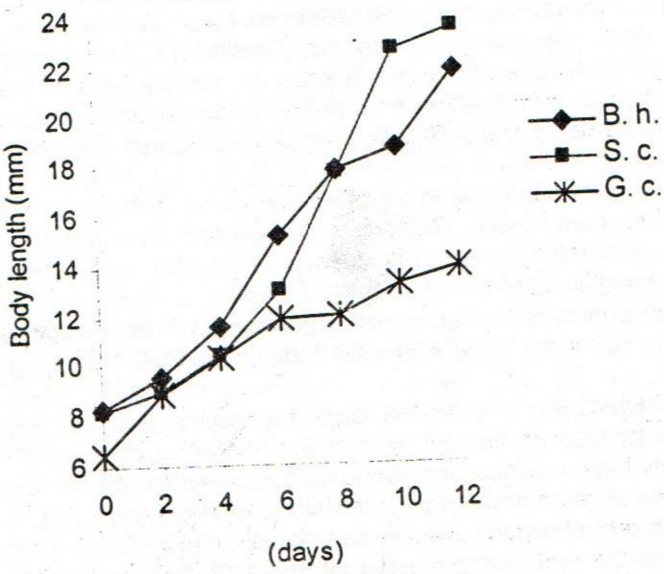
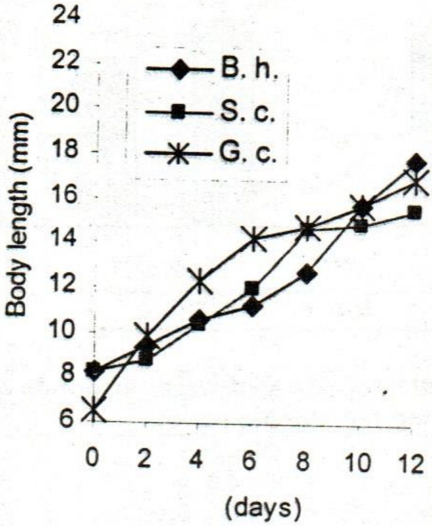


Figure (7): Growth of fry of B.H., S.c. and G.c. After stocking in slightly fertilized ponds



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 Cyclotalla 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.

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J. Agric. Sci. Mansoura Univ., 31 (5), May, 2006

تقييم الاحتياجات التسميدية لزريعة المبروك الصيني الفضي وكبير الرأس والحشائش أثناء فترة الحضانة

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تم اختبار معدلين مختلفين للتسميد لدراسة الاحتياجات التسميدية لثلاثة أنواع من زريعة المبروك الصيني الفضي وكبير الرأس والحشائش أثناء فترة الحضانة التي استغرقت اثني عشر يوما بعد فترة امتصاص كيس المح. استخدمت لهذه الدراسة مجموعتين من الأحواض الخرسانية كل مجموعة ثلاثة أحواض ، مساحة كل منها ٢٥ م٢ وكانت كثافة التحضين ٢٠، ١٠ ، ٥ زريعة للمتر المكعب من المياه للثلاثة أنواع علي التوالي. واستخدمت في المجموعة الأولي من الأحواض معدلات تسميدية عالية ٠,٥كجم زرق دواجن/م٣ من المياه في التسميد الأساسي قبل التحضين بخمسة أيام ، وفي التسميد الدوري ٠,٢ كجم/م٣ يوميا أما المجموعة الثانية من الأحواض فقد استخدمت فيها معدلات تسميدية منخفضة ٠,٢٥ كجم/م٣ للتسميد الأساسي و ٠,١ كجم/م٣ للتسميد الدوري. وتمت متابعة معدلات النمو للزريعة وكثافة الهائمات (البلانكتون) في اللتر من مياه الأحواض وكذلك محتوي المادة العضوية في اللتركل يومين. وفي نهاية فترة التحضين تم قياس متوسطات أوزان الجسم لكل من الأنواع الثلاثة. ومن نتائج هذه الدراسة اتضح أن أنواع الهائمات انباتية التي سادت في المياه بعد التسميد ارتبطت بكمية التسميد ، إذ ظهرت بشكل سائد بعض أنواع الطحالب الخضراء (الكلوروفيتا) مثل السينيديسماس ، والبيدياسترام ، والأنكيستروديسماس ، وبعض الطحالب الخضراء المزرقة(السيانوفايتا) مثل الأوسكيللاتوريا ، والأنابينا في أحواض المجموعة الأولي التي تم تسميدها بمعدلات تسميدية أعلي. بينما سادت أنواع أخري من هذه الهائمات كـ الدياتومز من رتبة (الباسيللاريوفيتا) مثل النافيكيولا ، والسايكلوتللا عند استخدام معدلات تسميدية منخفضة في أحواض المجموعة الثانية. وكانت معدلات الإعاشة لنوعي كبير الرأس والفضي منخفضة ٧٠,٢ و ٧٥,١% علي التوالي في الأحواض ذات التسميد المنخفض بينما لمبروك الحشائش كانت معدلات الإعاشة أعلي (٨٧,٥%)، أما في الأحواض ذات معدلات التسميد المرتفع فقد زادت معدلات الإعاشة بالنسبة لكبير الرأس والفضي زيادة معنوية لتصبح ٨٩,٣ و ٨٢,٧% علي التوالي ، بينما قلت بشكل معنوي بالنسبة لمبروك الحشائش لتصبح ٧٢,٤%. كذلك كان أداء النمو في كبير الرأس والفضي ضعيفا وفي مبروك الحشائش عاليا تحت ظروف التسميد المنخفضة حيث وصل متوسط وزن الزريعة ٦٧,١ و ١٠٥,١ و ٦٥,٩ مرة من وزنها الأصلي علي التوالي، وفي المقابل في أحواض التسميد المرتفع كان أداء النمو عاليا بالنسبة إلي كبير الرأس والفضي ومنخفضا بالنسبة إلي مبروك الحشائش ، حيث وصل متوسط وزن الزريعة ٨٢,٦ و ١٦٢ و ٥٥,١ مرة من وزنها الأصلي علي التوالي. وعلى ذلك يستنتج أن الرعاية المبكرة لزريعة المبروك كبير الرأس والمبروك الفضي تتطلب معدلات تسميدية أعلي من التي تحتاجها زريعة مبروك الحشائش ، وكذلك يفضل أن تكون الرعاية المبكرة لكل نوع علي حدة لاختلاف الاحتياجات التسميدية لكل منها في هذه المرحلة.