EFFECT OF FERTILIZATION ON GROWTH CHARACTERISTICS OF *CYPRINUS CARPIO* CULTURED IN RICE FIELDS IN IRAQ

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ABSTRACT

This study was carried out to evaulate the effect of organic fertilization on the growth of common carp *Cyprinus carpio* cultured in rice fields and its effect on rice production as well as the possibilitd reducing the feed provided to fish. Four fields with an area of 100 m^2 were cultured Yasmine rice represented four treatments. Common carp fish were cultured in it with a weight of 100 g/fish and a culture density of 100 fish/field. In the first treatment, organic manure was added without providing fish feed, second treatment, organic manure was added with fish feed, the third treatment without adding organic manure with fish feed, and the fourth treatment without adding organic manure and without providing fish feed. The results of the statistical analysis rate showed that T2 showed a significant increased($p\leq0.05$) in relative and specific growth in T2 compared to all treatments followed by T3. The results of the statistical analysis of the characteristics of the rice yield showed the number of dahlias, number of grains / dahlia, weight of 1000 grains and grain yield, showed a significant difference ($p\leq0.05$) in T2 and T3 compared to T1and T4, while there were no significant differences($P>0.05$) between treatments for the weight of 1000 grains trait. the study concluded that it is possible to apply the fish farming system in rice fields in Iraq by using organic fertilization (cow waste) and adding supplementary feed, as the T2 treatment gave the best growth for fish and rice.

Key words: relative growth , specific growth, number of daliahs, cow waste

تأثير التسميد العضوي في بعض صفات النمو لأسماك الكارب الشائع المستزرعة في حقول الرز في العراق

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المستخلص

اُجريت الدراسة لمعرفة تأثير التسميد العضوي في نمو اسماك الكارب الشائع*Cyprinus carpio* المستزرعة في حقول الرز وتأثيره في انتاج الرز وامكانية الاستغناء عن العلف في تغذية الاسماك المستزرعة. استزرعت أربعة حقول بمساحة 100م^2 برز الياسمين مثلت أربعة معاملات واستزرعت فيها أسماك الكارب الشائع بمعدل وزن 100غم وبكثافة استزراع 100سمكة/حقل. المعاملة الاولى أُضيف السماد العضوي دون تقديم العلف للأسماك، وفي المعاملة الثانية أُضيف السماد العضوي مع تقديم العلف للأسماك، المعاملة الثالثة بدون اضافة السماد العضوي مع تقديم العلف للأسماك، المعاملة الرابعة بدون اضافة السماد العضوي ودون تقديم العلف للأسماك. أظهرت نتائج التحليل الأحصائي لصفتي معدل النمو النسبي والنوعي تفوق المعاملة الثانيةT2معنوياً ($p\leq0.05$)على بقية المعاملات، تلتها المعاملة الثالثة T3 التي تفوقت على المعاملتين الأولى والثانية T2وT1 على التوالي. بينت نتائج التحليل الاحصائي لصفات محصول الرز عدد الداليات، عدد الحبوب/ دالية، وزن 1000 حبة وحاصل الحبوب تفوق المعاملتين T2وT3 معنوياً ($p\leq0.05$)على بقية المعاملات، وفي الصفات نفسها تفوقت المعاملة T1 على المعاملة T4، في حين لم تظهر فروق معنوية ($P>0.05$) بين المعاملات بالنسبة لصفة وزن 1000 حبة. خلُصت الدراسة انه بالإمكان تطبيق نظام تربية الأسماك في حقول الرز في العراق باستخدام التسميد العضوي (مخلفات الأبقار) واضافة علف تكميلي إذ اعطت المعاملة T2 افضل نمو للأسماك والرز.

الكلمات المفتاحية: النمو النسبي، النمو النوعي، عدد الحبوب بالدالية، مخلفات الأبقار

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INTRODUCTION

Fish is considered one of the sources rich in the main nutrients such as proteins, vitamins, fats and minerals, it surpasses other animal sources with regard to the percentage of protein in their meat (18), fish is also considered as a good food source for many peoples (1).Fish farming in rice fields is one of the old methods used in fish culture, yet it is one of the best practical methods to activate the use of agricultural land, especially in poor countries, as it contributes to solving the problem of the shortage in animal protein production at cheap prices, and it is known that rice farms are distinguished in large areas, which increases the amount of fish production, especially since those farms are usually far from seas,and lakes (13). In general, rice fields require a large amount of water for cultivation, and due to the abundance of this water many fish species prefer rice fields as a suitable environment for growth (12). The rice growing season is also suitable for fish farming, as this period is characterized by abundant sunlight with temperatures higher than 15ºC, and this provides enough time for warm water fish to grow (17).The rice and fish share some of the main characteristics, which are that the rice crop grows in land submerged in water, and the preferred soil for fish breeding farms, which is also suitable for rice growth (5). The idea is that the fish waste acts as a free fertilizer that is very useful in increasing the fertility of the soil for the rice crop, thus eliminating or reducing the need for chemical or organic fertilizers and avoiding their negative effects from the environmental and economic point of view (15). On the other hand, fish cultured in rice fields constribte in eliminating some insects, algae and worms harmful to the rice crop, as they represent food for fish, and this helps the farmer reduce the use of pesticides while cultivating the rice crop and probably not needing it, this is beneficial from the environmental and economic side (4). The current study aims to determine the effect of using organic fertilization on the growth and production of fish and rice farmed together, and the possibility of reelucing the feeding provideel to fish.

MATERIALS AND METHODS

Study site: The experiment was designed on area of 400m^2. As the land was prepared and divided into four fields (treatments), the area of each field is 100m^2 with dimensions of 10m* 10m. Fish trenches surrounding the field were dug by a hand digging tool with a depth of 80 cm and a width of 50 cm. Yasmine rice was planted two weeks after preparing the land and when it reached a height of about 20 cm , it was flooded with water and fish were introduced to the rice field, as the experiment of cultivating fish in rice fields began until the rice and fish crops were harvested.

Rice cultivation

Rice crop was planted by scattering seeds in the middle of July in the form of lines with dimensions of 30 * 30 cm Then the land was abundantly watered, followed by light watering operations, until the seedlings germinated.

Experimental fish

A total of 400 healthy *Cyprins carpio* with an average weight of 100 g. After arriving at the experiment site, fish were placed in plastic barrels in preparation for transferring them to the trench water, 10 days remained for acclimatization, after which the actual experiment began. The fish were fed on a floating type diet that contained a protein content of 26.48%, and in the light of monitoring the acceptability of the farmed fish for feed, and due to the continued low water temperature, the feeding rates were reduced from 5 to 4, 3, 2 and 1% of body weight according to the duration of the experiment.

Experimental design

Fish were distributed as 100 fish for each of the four treatments, with an initial weight of 100 g:T1 Addition of organic manure (cow waste) without providing fish feed.T2 Adding organic manure (cow waste) and providing feed for fish.T3 Not adding organic manure (cow waste) while providing fish feed.T4 Not adding organic manure (cow waste) and not providing fish feed.

Environmental factors

The water temperature was measured using an alcohol thermometer. Dissolved oxygen in the water was measured using a kit containing three drops and a color gradient indicating the oxygen concentration. pH of water was

measured using a pHmeter. These tests were repeated every 15 days during the trial period of 84 days.

Pond fertilization

Organic manure was used, as rice fields (T1and T2) were fertilized with an amount of 500 kg /2500m^2 (20 kg fertilizer/rice field) (2) by making pits in the rice terrace and trenches in which organic fertilizer were placed, then the pits were backfilled, this process was repeated twice in the beginning and in the middle of the experiment.

Growth indices

Survival rate %: It was calculated according to the equation mentioned by Carlos (9):

Survival rate = (number of fish at the end of the experiment / number of fish at the beginning of the experiment) x 100

Relative Growth Rate (RGR) %

It was calculated according to the equation mentioned by Uten (25):

RGR= (W2-W1)/W1*100

W1 = first weight (g)

W2 = second weight (gm)

Specific Growth Rate (SGR)

It was calculated according to the equation mentioned by Brown (8):

S.G.R. =} (Ln W2 – L n W1) / (T2 – T1) { x 100

Ln W2 = the natural logarithm of the second weight at time T2

Ln W1 = natural logarithm of the first weight at time T1

T2 - T1 = time between the two weights

The studied field characteristics of the rice crop: One square meter of rice was harvested using a wooden frame m * m. Samples were taken randomly from the four treatments to study the following characteristics:

1- Grain weight per square meter and converted to ton / hectare.

2- Weighing 1000 pills, as 1000 pills were calculated from each treatment and were weighed using an electronic scale.

3- The number of dahlias per square meter.

4- The number of grains in a single dahlia .=

Statistical analysis

A Complete Randomized Design (CRD) was used to analyze the effect of experimental treatments on the studied traits, and the ready-made statistical program was used as in the method mentioned by Khshali and Al-Hillalli (3).

RESULTS AND DISCUSSION

Environmental factors: Environmental factors (temperature, dissolved oxygen and pH) were measured during the experiment period extending from mid-September to mid-December and they were within the safe ranges for the growth and survival of common carp (22) (Table 1).

Table 1. Temperature, dissolved oxygen and pH in rice field water

Treatment	September			October			November		
	pH	DO	Temp. (ºC)	pH	DO	Temp. (ºC)	pH	DO	Temp. (ºC)
T1	6.0-6.5	5-4	26-27	7.0-7.5	5	20-24	7.5-8.0	6-5	17-12
T2	6.0-6.5	5-4	27-28	7.0-7.5	5	21-25	7.5-8.0	6-5	17-12
T3	6.0-6.5	5-4	26-27	7.0-7.5	5	20-24	7.5-8.0	6-5	17-12
T4	6.0-6.5	5-4	27-28	7.0-7.5	5	21-25	7.5-8.0	6-5	17-12

Survival rates

The results for the survival rate (Table 2) showed that there were no significant differences (P>0.05) among the studied treatments, and no mortalities were recorded in T1 to which organic fertilizer was added, the survival rate in T3 and T4 were 99%, while it was 98% in T2 . Fish survival rates depend on the biological and environmental factors surrounding the fish such as stocking density, competition for food and water quality(14).

Table 2. Survival rates of fish farmed in rice fields

Treatment	Density (fish/field)	Initial average weight (g/fish)	Mortality	Survival rate (%)
T1	100	100	0	100 A
T2	100	100	2	98 A
T3	100	100	1	99 A
T4	100	100	1	99 A

The same vertically letters indicate that there are no significant differences (p>0.05)

It is evident from the results of Table (2) that the high survival rates and the low number of mortality in the studied treatments, which confirms the suitability of common carp fish for cultivation in rice fields. This may be due to several reasons, the most important of which are the increase in the amount of nutrients, the availability of natural food, the stability of the rice field environment and the lack of fluctuation of physical and chemical factors in the rice field environment (19).

Relative and specific growth rate

The results of the statistical analysis of the relative growth rate characteristic are shown in table (3),showed that there were significant differences between the studied treatments, as the second and third treatments were significantly superior for a period of 14 days, with a relative growth rate of 57.28 and 57.35%, respectively, compared to treatments T1 and T4, which recorded 7.886, 1%, respectively, and for the same period outperformed Treatment T1 over treatment T4 while no significant differences were recorded between treatments T2 and T3, while the second and fourth treatments for 28 days outperformed with a relative growth rate of 4.937 and 4.925%, respectively compared to treatment T1 which recorded 2.743%, and no significant differences were recorded between treatments T2 , T3 and T4, and between T1 and T3 for the same period, and treatment T2 significantly outperformed with a relative growth rate of 12.354% in period 42 over the rest of the treatments T1, T3 and T4 which scored 1.556, 3.315, 0.476%, respectively, and for the same period, treatment T3 outperformed the two treatments. T1 and T4, while there were no significant differences between the two treatments T1 and T4. And treatments T2 and T3 with relative growth rates of 6.025 and 7.837%, respectively, for a period of 56 days, outperformed treatments T1 and T4, and scored 1.093 and 0.231%, respectively, while no significant differences were recorded between treatments T2 and T3 and treatments T1 and T4 for the same period. The results of the statistical analysis showed that there were no significant differences between treatments in the period of 70 days, and in the period of 84 days, the highest relative growth rate for treatments T1 and T4 was 2.140 and 2.297%, respectively, while no significant differences were recorded between treatments T2 and T3, and between treatments T1. T3 and T4 for the same duration. As for the specific growth rate table (4), the results of the statistical analysis showed that there were significant differences between the studied treatments. The highest specific growth rate was in the second and third treatments for a period of 14 days, with a specific growth rate of 3.356, 3.273% / day, respectively, followed by T1, which recorded 0.541% / day. T4, which recorded 0.076% / day, while no significant differences were recorded between the two treatments T2 and T3 in the same period, while the second and fourth treatments were significantly ($P\leq0.05$) for a period of 28 days, with a specific growth rate of 0.370, 0.369% / day, respectively compared to the treatment T1, which recorded 0.207%/day, and no significant differences were recorded between treatments T2, T3 and T4, and between T1 and T3 for the same period, and in the 42-day period, the highest specific growth rate was in the second treatment, which scored 0.895%/day, followed by treatment T3 which recorded 0.250 %/day, while there were no significant differences between treatments T1 and T4 for the same period. In the period of 56 days, treatments T2 and T3 significantly ($P\leq0.01$), which scored 0.448 and 0.582%/day, respectively, were superior to treatments T1 and T4 by 0.083 and 0.017%/day, respectively, while no significant differences were recorded between treatments T2, T3 and treatments T1. and T4 for the same duration. The results of the statistical analysis showed that there were no significant differences between the treatments in the period of 70 days. In the period of 84 days, the highest specific growth rate for treatments T1 and T4 was 0.162, 0.174%/day, while there were no significant differences between treatments T2 and T3, and between treatments T1, T3 and T4 for the same period.

Table 3. Relative growth rate of common carp cultured in rice fields (mean ± standard error)

Treatment	Relative growth rate (%)					
	14 day	28 day	42 day	56 day	70 day	84 day
T1	7.886 1.024± B	2.743 0.925± B	1.556 0.229± C	1.093 0.216± B	1.083 0.221± A	2.140 0.004± A
T2	57.280 0.970± A	4.937 0.030± A	12.353 0.070± A	6.025 0.817± A	1.604 0.127± A	0.242 0.000± B
T3	57.350 0.480± A	3.425 0.300± AB	3.315 0.321± B	7.873 0.897± A	0.811 0.274± A	1.073 0.539± AB
T4	1.000 1.000± C	4.925 0.024± A	0.467 0.467± C	0.231 0.231± B	1.634 0.252± A	2.297 0.479± A
morale level	**	*	**	**	N.S	*

The different letters vertically indicate that there are significant differences (P≤0.05) among the means of the studied trait

Table 4. Specific growth rate of common carp cultured in rice fields (mean ± standard error)

Treatment	Specific growth rate (%/day)					
	14 day	28 day	42 day	56 day	70 day	84 day
T1	0.541 0.067± B	0.207 0.069± B	0.118 0.017± C	0.083 0.016± B	0.081 0.015± A	0.162 0.000± A
T2	3.356 0.078± A	0.370 0.002± A	0.895 0.004± A	0.449 0.059± A	0.122 0.010± A	0.018 0.000± B
T3	3.237 0.022± A	0.258 0.022± AB	0.250 0.024± B	0.582 0.064± A	0.062 0.021± A	0.082 0.041± AB
T4	0.076 0.076± C	0.369 0.001± A	0.035 0.035± C	0.017 0.017± B	0.124 0.019± A	0.174 0.036± A
morale level	**	*	**	**	N.S	*

The different letters vertically indicate that there are significant differences among the means of the studied trait

Feeding with artificial feed and the availability of natural food due to the use of organic fertilizer significantly improved the relative and specific growth rates of the farmed fish, especially in the first periods of the experiment from 14-56 days, this indicates that the nutritional needs of fish are not met by natural food only, but rather by supplemental feeding, especially in the early stages of growth of farmed fish.The resulting growth in rice fields that were not provided with any supplementary feed is attributed to the availability of natural food, and this applies to T1 and T4. Boyd (7) indicated that there is a strong positive relationship between fish growth and primary productivity in the fertilized ponds without the use of supplementary food.The study of Billah et al. (6) showed that feeding with artificial floating feed significantly affected the weight gain and relative growth rate of common carp fish compared to feeding with conventional feed (rice bran). Priyadarshini et al. (23)

conducted a study on the culture of common carp in ponds of 25 m^2, using four treatments (the first treatment: without feeding and adding fertilizer, the second treatment: adding poultry manure fertilizer at a rate of 2000 kg/ha at the beginning of the experiment and then adding 200 kg/ha). hectares every two weeks, the third treatment: feeding once a day at 5% of body weight, the fourth treatment: feeding with the addition of manure), with a culture density of 4 fingerlings / m^2 with an initial weight of 3.2 g. The highest specific growth rate was observed in the treatment of manure and feed and in the feed treatment also recorded 2.62 and2.29%/ day ,respectively. Saowakoon et al. (24) found that the specific growth rate of common carp fish in the rice field ranged between 1.99-2.11%/day, as no supplementary feed was provided in the rice field during the experiment and cow manure fertilizer was used for 90 days in each A rice field at a rate of 37 g/m^2, as common carp fish grew faster than other species, followed by silver barb, *Barbonymus gonionotus*, then *Oreochromis niloticus*. Mohanty et al. (20) reported specific growth rates of more than 3%/day for herbivores fish and omnivores fish in the rice and fish diet with daily supplemental feeding.

Characteristics of rice

The results of the study on the productive characteristics of rice (Table 5) showed that T2 was significantly differences ($P\leq0.05$) compared to the rest of the treatments in the number of dahlias, followed by T3, and then the T1 and T4, which did not show significant differences ($p>0.05$) between them. The number of dahlias, as T2 was significantly differences ($p\leq0.05$) to the number of grains over the rest of the treatments, and this superiority of the two traits directly affected the trait of grain yield, as T2 was significantly increased ($p\leq0.05$) with an average grain yield of 2.35 tons/ha over the rest of the treatments, while the lowest mean grain yield in T4 was 0.85 ton/ha, and for the same trait, no significant differences ($P>0.05$) were recorded between T1 and T3. As for the trait of weight of one thousand grains.No significant differences ($p>0.05$) were recorded between T2 and T4, nor among T1, T3 and T4.

Table 5. Effect of common carp culture in rice fields on the number of dahlias/m^2, number of grains/dal, weight of 1000 grains/g, and grain yield (tons/ha) (mean ± standard error)

Treatment	Some productive characteristics of rice			
	number of dahlia (Dalia/m2)	Number cereal (grain/dalia)	grain yield (tons/ha)	weight 1000 grain (g)
T1	135±1 C	146±1 C	1.30±0.10 B	18±1 B
T2	223±2 A	173.50±1.50 A	2.35±0.050 A	21.50±0.50 A
T3	145.5±0.50 B	155±1 B	1.55±0.050 B	18.50±0.50 B
T4	132±1 C	128±1 D	0.85±0.050 C	20.50±0.50 AB
morale level	**	**	**	*

The vertically different letters indicate that there are significant differences($P\leq0.05$) between the means for the studied trait

It is clear from the review of the results of Table 4 that the T2 and T3 were superior throughout the duration of the experiment, which had high fish growth indicators compared to T1and T4, the reason for this may be due to the abundance of nutrients resulting from the addition of feed (20), and to an increase in the amount of fish waste in T2 and T3 and an increase in the movement of fish and their digging to the bottom in search for food , which led to the stirring and aeration of the soil and the release of nutrients inside the field and facilitating their absorption from the rice plant feeding fish on jungles , worms and

harmful insects, as well as phytoplankton competing with the rice crop, has increased the productivity of the rice crop, while the oxygen supply increases as it is one of the products of the photosynthesis process of plants, in addition to the fact that flipping and scraping the surface of the soil and layer oxidation promotes the growth of roots in rice plants (21).The activity and movement of the common carp during the search for food greatly increases the dissolved oxygen, which leads to accelerating the activities of microorganisms through which the organic matter is broken down and the renewal and release of nutrients for absorption from the rice plant, thus increasing the rice productivity in the integrated agriculture of rice and fish (11).Gurung and Wagle (11) found that the rice yield of 3.67 tons/ha was 9% higher than that of rice cultured alone (3.37 t/ha). Dey et al. (10) indicated that there was an increase of 6.73% of the rice yield per hectare in the rice and fish farming system compared to rice farming alone. (16) Kadhim noted in his study, which aimed to determine the optimum density of fish cultured in rice fields, in which four experimental treatments were used, three of which were cultured with rice and fish at densities of 50, 100 and 150 fish/field at an initial weight of 50 ± 3 g/fish, and fourth field rice only (without fish), that the fields in which fish were cultured with different culture densities had higher rice productivity than the rice field grown alone without fish, and the culture density of 150 fish/100 m^2 gave the best productivity of the rice crop and amounted to 5.17 tons/ha.In a study conducted by El-Shiblawy (4) with the aim of determining the optimal initial weight for the culture of common carp fish in rice fields, four treatments of fish with different initial weights of 50, 100, 150 and 200 g/fish/treatment and equal densities of 100 fish/field were used, the fields in which fish were cultured with different initial weights had high rice productivity, and the fourth treatment with initial weight of 200 g gave the highest rice productivity and reached 5.32 tons/ha. According to the results above .

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