

EFFECT OF POLYCULTURE ON THE GROWTH AND PRODUCTION OF FISH AND RICE FARMED TOGETHER

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ABSTRACT

This study was aimed to investigate the effect of farming of two fish species on growth traits of cultured fish and some yield components of rice crop. The field was divided into four fields planted with rice seedling, the area of each field was 100 m², after which two species of fish were released: the common (Cyprinus carpio) and the grass carp (Ctenopharyngodon idella) in rice fields, four experimental treatments were used that were cultured with rice and fish, the first treatment included the culture of common carp alone, while the second treatment, the grass carp was cultured alone, the third treatment, The common carp and grass carp were cultured together by 50 fish each, and in the fourth treatment, the common and grass carp were cultured by 75 and 25 fish, respectively. The total weight gain and the relative, specific, and daily growth rate of the experimental fish were calculated, as well as some rice production traits. Results of the statistical analysis showed significant differences ($p \leq 0.01$) for the total weight gain and the daily, relative and specific growth rate for all treatments, T3 show as significant differences ($p \leq 0.01$) compared to the rest treatments, and the T4 showed as significant difference ($p \leq 0.01$) in comparison with T1. Results of the statistical analysis of the characteristics of the rice yield showed: as the T2 was significantly ($p \leq 0.01$) superior to other treatments, followed by the T4, which outperformed the T1 and T3 treatments. In the same traits, the T3 treatment outperformed the T1.

Key words: Common and grass carp, relative growth, specific growth



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INTRODUCTION

Aquaculture in general and fish farming in particular are among the fastest growing agricultural sectors in the world, in addition to the fact that it occupies an advanced position in the human diet because of its great importance in the growth and building of the body (Ibrahim & Al-Khshali, 2019). Common carp represents the most important freshwater species suitable for breeding due to its great advantages, as it contributes 71.9% of the production of water fresh fish because of its rapid growth and its ability to withstand poor environmental conditions and changes in temperature and oxygen (Al-Jader & Al-Khshali, 2021). Fish farming in rice fields is one of the old methods used in fish farming, but it is one of the best practical methods to activate the use of agricultural lands, especially in poor countries, where it

contributes to solving the problem of fish shortage and protein production at cheap prices. Fish farming with rice in integrated systems leads to the possibility of optimal use of resources while minimizing damage to ecosystems to achieve economic benefits (Lv et al., 2019). Fish in rice fields provide a mutually beneficial relationship between rice crops and fish, as farmed fish feed on insects, algae and worms harmful to the rice crop, in addition to that fish waste represents an organic fertilizer that improves soil properties, which increases the productivity per unit area of the rice field at a rate ranging between 10 and 12% per 2500 square meters, and thus increases the cash return of the farmer by increasing rice and fish together (Al-Shiblawi & Al-Khshali, 2022).

MATERIALS AND METHODS

Study site and experimental fish: The experiment was conducted during the period from 6/7/2022 to 7/12/2022 with an area 400 m² (20 * 20m), The land was prepared and divided into four treatments, the area of one field was 90.25m², with dimensions of 9.5 x 9.5m, fish surrounding trenches were dug by a manual digging machine with a depth of 80 cm and a width of 50 cm, thus the total area of the slab with the trench became 100 m² with dimensions of 10 * 10 m. The rice crop, *Oryza sativa* was sown on 21/7/2022, and when it reached a height of about 20 cm, the field was flooded with water, fish were released into the rice field on 9/4/2022, The experiment was continued until the harvest period, as the rice and fish crops were harvested on 7/12/2022. On 4/9/2022, A total of 400 fish of common carp and grass carp were bathed in 3% nacl for 5 minutes to remove the external parasites, with an average weight of 100g, the fish were sterilized with a sodium chloride solution (5 g/L table salt), then the fish were released into the ditch water, and they stayed for 5 days, a period of acclimatization until 9/9/2022, the fish farming experiment began and continued until 7/12/2022.

Rice cultivation: Yasmine rice seedlings were brought from a farmer, the four fields were planted with the rice crop in the lines with dimensions of 25 cm * 25 cm, and a distance of 50 cm was left between each square meter, after irrigated, the land was abundantly watered.

Experiment design: According to Kazem (2020), fish treatments were distributed at the rate of 100 fish for each of the four treatments, with an average initial weight of 100 gm / fish, according to Al-Shiblawi(2021):

T1: Only Common carp (100 fish).

T2: Only Grass carp (100 fish).

T3: Common carp, 50 fish, and grass carp, 50 fish.

T4: Common carp, 75 fish, and grass carp, 25 fish.

The water temperature and were , dissolved oxygen and pH were measured.

Fish studied traits

Total weight gain (T.W.G.): Calculated from the equation mentioned by Al-Shiblawi and Al-Khshali (2022):

$$TWG = FW - IW$$

where:

FW= Final weight (g)

W= Initial weight (g)

Daily growth rate (D.G.R.): Calculated from the equation mentioned by Al-Hilali and Al-Khshali (2019):

$$D.G.R. = (W2 - W1) / (T2 - T1)$$

Where: W1 = first weight (g)

W2 = second weight (g)

T1-T2 = the time period of the experiment or between the two weights in days.

Relative growth rate (R.G.R.)

Calculated according to the equation mentioned by Al-Khshali (2019):

$$RGR = [W2 - W1] / W1 \times 100$$

Where:

W1 = first weight (g)

W2 = second weight (g).

Specific Growth Rate % (SGR)

$$S.G.R. = \{ (\ln W2 - \ln W1) / (T2 - T1) \} \times 100$$

where:

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

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

T2 - T1 = the time between the two weights

Yield characteristics of rice crop

A square meter of rice plants were harvested using a m * m wooden frame, samples were taken randomly from the four treatments to study the following characteristics:

1- Grains weight per square meter and converted to tons / hectare.

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

3- The number of panicles per square meter.

4- The number of grains in one panicle

Statistical analysis: The Complete Randomized Design (CRD) was used to analyze the effect of the experimental treatments for the characteristics that were studied using the statistical program (SAS) (2012).

RESULTS AND DISCUSSION

Total gain weight and daily growth rate:

Results of the statistical analysis (Table1) shows significant differences ($P \leq 0.01$) among the four treatments in terms of total weight gain and daily growth rates. The three treatments of common carp T1, T3 and T4 recorded a total weight gain of 88.75, 119.6 and 97 g/fish/treatment respectively during the period of the experiment, grass carp were recorded in T2, T3 and T4 total weight gain amounted to 43.7, 62.75 and 31.95 g/fish/treatment, respectively, while common carp T1, T3 and T4 recorded a daily growth rate of 1.06, 1.43 and 1.15 g/day/fish, respectively. T2, T3 and T4 of grass carp recorded a daily growth rate of 0.52, 0.75 and 0.38 g/day/fish, respectively. Treatment T3 was significantly ($P \leq 0.01$) in terms of total weight gain and daily growth rate over the rest of the treatments, followed by T4, T1, then T2. Results in Table (1) Show that the rate of total weight gain and daily growth rate reached highest levels in the T3 two fish species of were cultured at equal densities (50 common carp and 50 grass carp). This superiority may be attributed to the fact that common carp tends to feed on animal nutrition, as they feed mainly on crustaceans, aquatic insects, molluscs, annelids, herbs and seeds. As well the common carp scrapes the bottom with its mouth, as it are mainly consumes zooplankton

in earthen ponds when high rearing densities, as for the grass carp, they are herbivorous, they feed on wild and aquatic plants, they prefer soft ones and soft ferns are their favorite food. (Matsuzaki et al., 2007). Guo et al. (2022) noted that 50.2% of common carp food was from the field environment of rice and not from the used fodder when analyzing the food sources in the rice field. Hussain et al. (2018) indicated that they get weight gain ranged between 133-189 for common carp when polycultured with *Barbodes goninotus*, *Labeo rohita* and *Cirrhinus mrigala* in the rice field after 90 days of culture. Gurung and Wagle (2005) reported that fish growth and production in a paddy field depends on the quality and availability of food, area of the field, initial weight of fish, predation and mortality, and other factors. Sometimes the presence of fish reared in rice fields may be limited to trenches due to the low water level, and in such a case if the fish cannot reach the main parts of the paddy field for grazing, the effectiveness of the fish in controlling weeds, pests and bushes will be little or no, this leads to poor rice and fish production (Guo et al., 2020). On the other hand, current systems of fish farming in rice fields often include the use of supplementary feed in addition to the natural food in order to obtain a high productivity of fish (Hu et al., 2016).

Table1. Initial, final and total weight gain and daily growth rate of common carp and grass carp cultured in rice fields (mean \pm standard error)

Duration treatments	Fish species	Initial weight (g/fish)	Fish weight (g/fish every 14 days)					Final weight (g/fish)	Total weight gain (g/fish)	Daily growth rate (g/day/fish)
			14	28	42	56	70			
T1	common carp	104.5 0.5 \pm	130.98 0.03 \pm a	145.05 0.05 \pm a	165.5 0.5 \pm b	177.5 0.5 \pm b	185.5 0.5 \pm b	193.25 0.25 \pm c	88.75 0.25 \pm c	1.06 0.01 \pm c
	grass carp	103.5 0.5 \pm	117.5 0.5 \pm d	123.5 0.5 \pm d	136.5 0.5 \pm d	142.5 0.5 \pm d	144.25 0.25 \pm d	147.2 0.2 \pm e	43.7 0.3 \pm e	0.52 0 \pm e
T2	common carp	96.5 0.5 \pm	130.5 0.5 \pm a	145.5 0.5 \pm a	170.5 0.5 \pm a	186.2 0.2 \pm a	198.25 0.25 \pm a	216.1 0.1 \pm a	119.6 0.6 \pm a	1.43 0.01 \pm a
	grass carp	104.5 0.5 \pm	120.5 0.5 \pm c	135.5 0.5 \pm c	150.5 0.5 \pm c	160.5 0.5 \pm c	164.5 0.5 \pm c	167.25 0.25 \pm d	62.75 0.25 \pm d	0.75 0.01 \pm d
T3	common carp	97.5 0.5 \pm	124.5 0.5 \pm b	142.3 0.3 \pm b	165.15 0.15 \pm b	178.35 0.35 \pm b	186.5 0.5 \pm b	194.5 0.5 \pm b	97 0 \pm b	1.15 0 \pm b
	grass carp	100.5 0.5 \pm	112.5 0.5 \pm e	116.5 0.5 \pm e	126.5 0.5 \pm e	130.5 0.5 \pm e	131.5 0.05 \pm e	132.45 0.45 \pm f	31.95 0.05 \pm f	0.38 0 \pm f

Relative and specific growth rate of fishes:

The results of the statistical analysis of the relative growth rate (Table2) Show significant differences($p \leq 0.01$) among the studied treatments, as the T3 excelled significantly for a period of 14 days with a relative growth rate of 35.24% compared to T1 and T4 for common carp, while T2 and T3 excelled in relative growth rate of 13.53 and 15.32%, respectively, T4 for a period of 28 days, with a relative growth rate of 14.3%, excelled

compare the two T1 and T3 for common carp, while the T3 excelled with a relative growth rate of 12.45% over the T2 and T4 for grass carp, the T3 was significantly superior ($p \leq 0.01$) in the period of 42days with a relative growth rate of 17.18% over T1 and T4 for common carp, the T2 and T3 excelled at a relative growth rate of 10.53 and 11.07%, respectively, compared the T4 for grass carp. T3 excelled at a relative growth rate for 56 and 70 days for common carp and grass carp.

Table2. Relative growth rate of common carp and grass carp cultured in rice fields (mean \pm standard error)

period	Fish species	Relative growth rate (%)					
		14 day	28 day	42 day	56 day	70 day	84 day
treatments							
T1	Common carp	25.23 0.63 \pm b	10.75 06.0 \pm c	14.095 39.0 \pm c	7.25 0.2 \pm c	4.51 0.221 \pm b	4.18 0.42 \pm b
	grass carp	13.53 1.03 \pm cd	5.11 0.03 \pm d	10.53 0.05 \pm d	4.395 0.02 \pm d	1.23 0.53 \pm d	2.05 0.04 \pm c
T3	Common carp	35.24 0.19 \pm a	11.495 0.05 \pm bc	17.18 0.06 \pm a	9.21 0.44 \pm a	6.47 0.02 \pm a	9.01 0.09 \pm a
	grass carp	15.32 1.03 \pm c	12.45 0.05 \pm b	11.07 0.04 \pm d	6.65 0.03 \pm c	2.49 0.01 \pm c	1.67 0.46 \pm cd
T4	Common carp	27.695 0.145 \pm b	14.3 0.7 \pm a	16.06 14.0 \pm b	7.995 0.115 \pm b	4.58 0.49 \pm b	4.29 0.01 \pm b
	grass carp	11.95 1.06 \pm d	3.56 0.02 \pm e	8.59 0.04 \pm e	3.16 0.01 \pm e	0.73 0.35 \pm d	0.76 0.38 \pm d

Table3. Specific growth rate of common carp and and grass carp cultured in rice fields (mean \pm standard error)

Duration	Fish species	Specific growth rate (%/day)					
		14 day	28 day	42 day	56 day	70day	84day
T1	Common carp	1.62 0.04 \pm b	0.73 0 \pm c	.095 0.03 \pm c	0.5 0 \pm c	0.32 0.01 \pm b	0.29 0.03 \pm b
	grass carp	0.91 0.07 \pm cd	0.36 0.01 \pm d	.072 0.01 \pm d	0.31 0 \pm d	0.09 0.04 \pm d	0.15 0.01 \pm c
T3	Common carp	2.16 0.01 \pm a	0.78 0.01 \pm bc	1.14 0.01 \pm a	.063 0.0 \pm a	.045 0 \pm a	.062 0.01 \pm a
	grass carp	1.02 0.07 \pm c	0.82 0.01 \pm b	0.75 0 \pm d	0.46 0 \pm c	0.18 0 \pm c	0.12 0.03 \pm cd
T4	Common carp	1.75 0.01 \pm b	.096 0.05 \pm a	1.07 0.01 \pm b	0.55 0.01 \pm b	0.32 0.03 \pm b	0.3 0 \pm b
	grass carp	0.81 0.07 \pm d	0.25 0 \pm e	0.59 0 \pm e	0.22 0 \pm e	0.06 0.03 \pm d	0.06 0.03 \pm d
		**	**	**	**	**	**

In the period of 84 days, the highest relative growth rate for T3 was 9.01%, and no significant differences ($p \leq 0.01$) were recorded between treatments T1 and T4 for common carp, while the highest relative growth rate for grass carp was in T2 and T3 by 2.05 and 1.67%, respectively, compared to the T4, which recorded a relative growth rate of 0.76%, and no significant differences ($p \leq 0.01$) were recorded between T2 and T3, and between T3 and T4 of grass carp for the same period. As for the fish specific growth rate (Table 3), The results of the statistical analysis show significant differences among ($p \leq 0.01$) the studied treatments, the third treatment for a period of 14 days, with a specific growth rate of 2.16%/day, outperformed the two T1 and T4, which recorded 1.62 and 1.75%/day respectively for Common carp, respectively, T2 and T3, with a specific growth rate of 0.91 and 1.02%/day, respectively, were superior to the T4 of grass carp. In the period of 56, T3 was superior compare the T1 and T4, and recorded 0.63%/day while T4 was superior to the first treatment for the same period of common carp, T2 outperformed T4 for the same period of grass carp. The results of the statistical analysis in the period of 70 days show that T3 had a specific growth rate of 0.45%/day compare the two T1 and T4, which recorded a specific growth rate of 0.32 and 0.06%/day, respectively, and no significant differences ($p \leq 0.01$) were recorded between T1 and T4 for the same period for common carp. The third treatment, with a specific growth rate of 0.18%/day, was superior to the second and fourth treatments of grass carp. In the period of 84 days, T3 excelled at a specific growth rate of 0.62%/day compare T1 and T4, while no significant differences were recorded between T1 and T4 for the same period for common carp, and no significant differences were recorded between T2 and T3 and between T2 and T4 for the same period for grass carp. It can be noted reviewing the results of Tables 3 and 4 Show the relative and specific growth rates were positive effect because the field water temperature was suitable for the growth of the cultured fish, while the gradual decrease in temperature during the experiment period had a negative

effect on the relative and specific growth rate of the cultured fish in the last days of the experiment, may due to the decrease in fish activity, poor appetite, lack of food intake, as well as low rates of metabolism in the body, This is consistent with what several studies indicated that the relative and specific growth rate are closely related to temperatures, it is observed that the relative and specific growth rates are low for many species of warm water fish when the temperature drops to less than 15 °C (Mallekh et al., 1998; Mridha et al., 2017). Oyugi et al. (2012) emphasized that water temperature has an important effect on the growth rate of common carp, as the best specific growth of fish was achieved at a temperature ranged between 20-24° C, compared to temperatures that ranged between 16-28 °C. Mohanty et al. (2004) indicated that the specific growth rates increased by 3%/day for herbivores and omnivores fish in the rice-fish system with daily supplementary feeding. Rahman et al. (2008) noted that the growth of common carp in the mixed culture with the Indian carp, *Labeo rohita*, was higher with the supplementary feed, and the availability of natural food, they explained this by the possibility that artificial feeds act as fertilizers, which leads to an increase in the amount of natural food through the high concentrations of nutrients, they also recorded an increase in the consumption of benthic invertebrates, copepods and rotifers, and a decrease in the consumption of phytoplankton in general. The results of an experiment conducted by. Billah et al. (2020) showed that feeding with artificial floating feed had a significant effect on the weight gain and relative growth rate of common carp, amounting to 180.9 g and 2.4%, respectively, compared to feeding with traditional feed (rice bran only), as Nile tilapia and common carp were cultured in rice fields with a stocking density of 6 fingerlings/m² at a rate of 1:1, and a feeding rate of 8% of body weight with an initial weight of 7.25 g, the number of feeding times (one-five times/week) did not affect weight gain and growth rate, the researchers attributed this results to the availability of natural food in the rice field, as natural food is considered one of the important sources of nutrients in the rice field which

contains 51.1% protein and 27.3% carbohydrates, in addition to 7.7% fat, while its calories ranged from 6.7 to 23.8 kcal/gram (Musa et al., 2023). Guo et al. (2020) found that the method of rice cultivation affects the specific growth rate of fish, as three dimensions (spacing) were used in rice cultivation: 20×30 cm, 30×30 cm, and 40×30 cm, the results showed that the highest specific growth rate of fish was in the medium rice density group (30 x 30 cm) and amounted to 4.54%/day, which was much higher than that in the high density group (20 x 30 cm) which recorded 3.62%, while the lowest density (40 x 30 cm) recorded a specific growth rate of 4.19. %, this explains that the spacing between the seedlings of the rice plant provides a suitable environment for the fish and reduces stress, this was reflected in the specific growth rate without negatively affecting the yield of rice.

Rice characteristics: Results of yield characteristics of rice (Table4) show that T2 was significantly different (P≤0.01) compared to the rest of the treatments with the number of

panicles, they amounted to 343 panicles/m², followed by T4 that amounted to 303.5 panicles/m², then T1 and T3, which amounted to 241 and 292 panicles/m², respectively, The results of the number of grains/ panicles are similar to the results of the characteristic of the number of panicles in terms of significance, as T2 was significantly superior in terms of the number of grains compared the rest of the treatments and amounted to 173.5 grains /panicles, followed by T4, which amounted to 140.5 grains /panicle, then T3, which reached 125.5 grains /panicles, and was the lowest number of grains in T1, it amounted to 111 grains /panicle, and this superiority of the two traits directly affected the characteristic of grain yield, as T2 was significantly different (p≤0.01) to the rest of the treatments, with an average grain yield of 0.99 tons / dunum, followed by T4, which amounted to 0.92 tons / dunum, then T3, which amounted to 0.51 tons / dunum, the lowest grain yield in T1 was 0.48 tons/dunum. As for the weight of a thousand grains,

Table 4. Effect of different treatments for carp culture in rice fields on some yield characteristics of rice: number of panicles/m², number of grains/panicle, grain yield, weight of 1000 grains/gm, biological yield and grain yield (ton/dunum) (average ± standard error)

Treatments	Some yield characteristics of rice				
	number of panicles (panicle/m ²)	grains/panicle	grain yield (ton/dunum)	Weight of 1000 of grains(gm)	biological yield (ton/dunum)
T1	241±1 d	111±1 d	0.48±0.0001 d	16.5±1.5 b	1.92±0.025 d
T2	343±1 a	173.5±1.5 a	0.99±0.001 a	21±1 ab	2.53±0.025 b
T3	292±2 c	125.5±1.5 c	0.51±0.0001 c	22.25±1.75 a	2.73±0.02 a
T4	303.5±1.5 b	140.5±1.5 b	0.92±0.001 b	21.5±0.5 ab	2.31±0.001 c

T3 recorded the highest weight of a thousand grains and reached 22.25 gm, followed by T4 with 21.5 g, then T2 with 21 g, while T1 recorded the lowest weight of a thousand grains and amounted to 16.5 gm, for the same trait no differences were recorded. Significant among the treatments T2, T3 and T4 and not among the treatments T1, T2 and T4. As for the characteristic of the biological yield, T3 excelled over the rest of the treatments and recorded 2.73 tons/dunum, followed by T2 which reached 2.53 tons/dunum, then T4 which reached 2.31 tons/dunum, and the lowest biological yield was in T1 with 1.92

tons/dunum. It is clear from reviewing the results of the yield characteristics of rice (Table 5) that T2 and T4 were superior in most of the experiment period, that is may due to the increase in the amount of waste excreted from the fish in these two treatments, and the movement of the fish, the superiority of T2, in which 100 grass carp were cultured in most of the productive characteristics of rice, may be attributed to the fact that the grass carp, by virtue of its vegetarian diet, may have fed on phytoplankton that compete with the rice plant for the nutrients in the rice field, and thus nutrients such as nitrogen and phosphorus

became available only to the rice plant without others, which was reflected in most of the productive characteristics of rice. As for the superiority of T4, in which 75 fish of common carp and 25 fish of grass carp were cultured, in some productivity characteristics of the rice crop, it may be attributed to the state of biological and environmental balance in this treatment, and that the two species of fish benefited from the water column in the fish trenches without interference or competition for food and place, as the common carp dig holes in search of food, which leads to stirring and aeration of the soil and the releasing of nutrients inside the fields, that facilitates their absorption from the rice plant, and that the feeding of fish, especially the common carp, on harmful insects, bushes, worms, and phytoplankton competing for the rice crop. besides, it works to increase the productivity of the rice crop, while the oxygen supply increases as it is one of the products of the photosynthesis process of plants, also the scraping and stirring of the soil surface stimulates oxidation of its layers and promotes root growth in rice plants (Mohanty et al., 2009). Wan et al. (2019) mentioned that fish farming in rice fields contributed to increasing the productivity of the rice crop, which gave a grain yield of 8.74 tons/ha, compared to rice cultivation alone, which gave 8.01 tons/ha this is due to the increase in the grains weight of the rice plant, as the weight of 1000 grains reached 27.65 g in rice and fish fields, compared to monocultures 26.32 g in single rice fields, this was attributed to the accumulation of fish waste, which is one of the nitrogen fertilizers necessary for the rice plant, in addition to the fact that the deep water in the rice fields changes some of the atmosphere inside the fields, such as adjusting and moderating temperatures, and the slow process of losing nutrients available in the soil, thus giving a longer period of time for the rice plant to make optimal use of these elements. Guo et al. (2022) confirmed that it is possible to increase the production of rice crop through fish farming, since 13-35.1% of the nitrogen in fish feed is absorbed by rice plants, they note that the nitrogen in the consumed or unconsumed feed was released by

decomposition or absorbed by rice plants. Matsuzaki et al. (2007) indicated that nitrogen is one of the most important nutrients affecting the increase of rice yield in irrigated rice fields, as an increase of 6.73% of rice yield per hectare was recorded in the rice and fish farming system compared to rice farming alone. Mridha et al. (2017) that when cultivating *Oreochromis niloticus* in rice fields for a period of 120 days, observed an increase in grain yield when supplementary food was added to fish cultured inside rice fields, due to the improvement of water quality in rice fields, especially in trenches, which leads to an abundance of nutrients. Phosphorus and nitrogen resulting from fish waste and the decomposition of unconsumed food residues and increasing their concentration in the soil of the rice field. In an experiment conducted by Suganthi et al. (2015) for a period of three years (2015-2018) to compare the common cultivation of rice and fish *Aptrichtus kendalli* and the cultivation of rice alone without fish (rice alone) in China, it was noted that fish reduced the proportion of insects harmful to rice plants by 24.07%, it also reduced the percentage of jungles by 67.62, 62.01 and 58.88%, respectively, for the study period in the three years.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

The authors declare that they have not received a fund.

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تأثير التربة المتعددة في نمو وانتاج الاسماك والرز المستزرعان معاً

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المستخلص

هدف البحث، معرفة تأثير استزراع نوعين مختلفين من الأسماك في صفات النمو للأسماك المستزرعة وبعض الصفات الانتاجية لنبات الرز. قُسمت الارض إلى أربعة حقول زرت بالرز، مساحة كل حقل 100 م²، تم إطلاق نوعين من الأسماك هما الكارب الشائع *Cyprinus carpio* والكارب العشبي *Ctenopharyngodon idellus* داخل حقول الرز، استخدمت أربع معاملات تجريبية استزرعت بالرز والأسماك، تضمنت المعاملة الاولى استزراع سمك الكارب الشائع لوحدها، وفي المعاملة الثانية استزرعت سمك الكارب العشبي لوحدها، في حين استزرعت في المعاملة الثالثة أسماك الكارب الشائع والعشبي معاً بواقع 50 سمكة لكل منهما، وفي المعاملة الرابعة استزرعت أسماك الكارب الشائع والعشبي بواقع 75 و25 سمكة بالتتابع، تم حساب الزيادة الوزنية الكلية ومعدل النمو النسبي والنوعي واليومي لأسماك التجربة فضلاً عن بعض الصفات الانتاجية للرز. بينت نتائج التحليل الإحصائي تسجيل فروق معنوية ($p \leq 0.01$) للزيادة الوزنية الكلية ومعدل النمو اليومي والنسبي والنوعي للمعاملات جميعها، إذ تفوقت المعاملة T3 على بقية المعاملات، وتفوقت المعاملة T4 على المعاملة T1. وأظهرت نتائج التحليل الإحصائي لصفات محصول الرز: تفوق المعاملة T2 معنوياً ($p \leq 0.01$) على بقية المعاملات تلتها المعاملة T4 التي تفوقت على المعاملتين T1 وT3.

الكلمات المفتاحية: أسماك الكارب الشائع والعشبي، النمو النسبي، النمو النوعي، عدد الحبوب بالدالية