# Utilization of blue green alga (Anabena wisconsinense) as a feeding and biofilterization for Nile tilapia (Oreochromis niloticus) cultivation in rice fields



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# UTILIZATION OF BLUE GREEN ALGA (*ANABAENA WISCONSINENSE*) AS A FEEDING AND BIOFERTILIZATION FOR NILE TILAPIA (*OREOCHROMIS NILOTICUS*) CULTIVATION IN RICE FIELDS

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**Key Words:** Nile tilapia *(Oreochromis niloticus)*, Growth performance, varying fertilizing inputs, dried blue green alga (*Anabaena wisconsinense*), rice fish culture, productivity, economical efficiency.

## ABSTRACT

This study has been carried out to investigate the growth performance and economic efficiency as well as pond productivity of Nile tilapia *(Oreochromis niloticus)* fingerlings cultured in rice fields as affected by dried blue green alga (*Anabaena wisconsinense*) for nutrition and fertilizing inputs. Nile tilapia fingerlings average 25 g in weight were assigned randomly to four tested different feed and fertilized inputs. Eight rice fields (one feddan each) were cultivated by rice and divided into four treatments, each treatment was carried out in two ponds replicates. Each pond included stocked 1200 Nile tilapia *(Oreochromis niloticus)* fingerlings density. The first treatment received commercial complete pelleted fish feed (artificial diet) containing 30% CP and fed at a daily rate of 5 % of fresh fish body weight from three time daily and five days per week ($T_1$). The second treatment received pelleted fish feed containing 50% dried blue green alga (*Anabaena wisconsinense*) plus 50% artificial diet and fed at a daily rate of 5% fresh fish body weight from three time daily and five days per week ($T_2$). The third treatment received each ponds was fertilized biweekly 7.5 kg. ammonium sulphate ($T_3$). The fourth treatment did not receive any commercial feed, but have only natural feeding and fertilized biweekly 5 kg. dried blue green alga (*Anabaena wisconsinense*) ($T_4$). The study extended 90 days. Results obtained can be summarized in the following:

1- The highest final body weight, average daily gain (ADG) and specific growth rate (SGR) were recorded for Nile tilapia fish group in $T_2$, while a reverse tend was observed with survival rate in $T_4$.
2- With regard to economic efficiency, the total cost of $T_1$ was the highest but a net return of $T_2$ was the highest.

In conclusion, the use of dried blue green alga (*Anabaena wisconsinense*) in fish pond culture could be recommended for Nile tilapia fish, especially with the high cost of fish diets and fertilizers found now.

## INTRODUCTION

In aquaculture, feed is the most expensive cost item, commonly contributing between 40-70% of total variable expenses. *Anabaena wisconsinense* is a freshwater blue-green filamentous alga, and receiving increasing bioactive components such as vitamins, minerals, polyunsaturated fatty acids, carotenes and other pigments that have antioxidants activity **(Cohen and Vonshak, 1991; Lin *et al.*, 2007; Wang *et al.*, 2007)**. The previous studies recommended that blue-green algae *Anabaena wisconsinense* could be used to produce a natural dietary antioxidant supplement or added to healthy food products, to prevent some chronic diseases. Moreover, *Anabaena wisconsinense* is a rich source of protein , vitamins, essential amino acids, minerals and essential fatty acids such as palmitic acid, linolenic acid, and linoleic acid. Therefore, it has been used as a nutrient for fish larvae **(Lu *et al.*,2002)** and as an ingredient in fish diet for juveniles and adults common carp **(Nandeesha *et al.*, 1998)**. Protein is the principal and most expensive component of the diet, where the protein sources in tilapia feeds comprising 55-75% of the dietary material cost. Consequently protein cost is usually given the first priority in formulating fish feeds **(Hanley, 2000)**. **Bakeer *et al.*,(2003)** reported that the grass carp (25g.) which fed on blue green algae plus Lucerne (5% of body weight/5days a week for 150 days) cultured in earthen ponds recorded the highest final body weight and specific growth rate. A few years ago, microalgae have been increasingly produced for commercial purposes which include human and animal consumption, bioactive compounds for medicine, fuel production, biofertilizers, and as live feeds for the cultivation of filter feeding organisms. Currently, microalgal biomass production is economically feasible only when product values are relatively high, such as special chemicals and pigments, or when the microalgae play a critical role in aquaculture production **(Spectorova *et al.*, 1997).** Microalgae have been investigated as a human animal food for over 40 years, the use of microalgae in aquaculture has several potential advantages over the production of microalgae for human foods or terrestrial animal feeds such as high conversion efficiencies and no need for harvesting, drying and storage, as the animals or food chains could use the algae as produced. However, the production of microalgae for aquaculture feeds has been relatively neglected, mainly, because the aquaculture system themselves were generally poorly developed **(Benemann, 1992).** Different techniques of clean algae production were developed, growing blue-green algal usually occur in abundance during the warm months of the year **(Fogg 1984). Abdel-Hakim *et al.*;(2000)** reported that the average body weight of Nile tilapia *(Oreochromis niloticus)* culture in rice fields has been increased from 4.08 to 81.97 g. and the rice yield increased by 148 Kg/feddan beside 77.9 Kg. fish/feddan. The total fish production in rice fields is about 20,000 tons as reported by **GAFRD (2001).**

The objective of the present study aimed to evaluate the effect of blue green algae (*Anabaena spp.*) , ammonium sulphate fertilization without artificial feeding and comparing with blue green algae (*Anabaena spp.*) feeding on the production of Nile tilapia (*Oreochromis niloticus)* fingerlings in rice fields.

## MATERIAS AND METHODS

***Location:***

The present study was carried out in a private rice farm at Kafr Elsheikh, Egypt, while the laboratory analysis was conducted at International Central Laboratory for Aquaculture Research Management. The WorldFish Center, Regional Center for Africa and West Asia, Abbassa, Abu-Hammad, Sharkia, Egypt.

***Fish culture and treatments:***

Eight rice fields (one feddan each) were cultivated by rice and divided into four treatments, each treatment was carried out in two ponds replicates. Each pond included stocked 1200 Nile tilapia *(Oreochromis niloticus)* fingerlings density. Within average initial weight of 25 g at the start of experiment. Rice was cultivated in the field at first 30 days, and then transplanted in the permanent rice fields, after 7 days of rice transplantation all ponds were stocked with fish fingerlings. The first treatment received commercial pelleted fish feed (artificial diet) containing 30% CP and fed at a daily rate of 5 % of fresh fish body weight from three time daily and five days per week ($T_1$). The second treatment received pelleted fish feed containing 50% dried blue green alga (*Anabaena wisconsinense*) plus 50% artificial diet and fed at a daily rate of 5% fresh fish body weight from three time daily and five days per week ($T_2$). The third treatment received each ponds was fertilized biweekly 7.5 kg. ammonium sulphate ($T_3$). The fourth treatment did not receive any commercial feed, but have only natural feeding and fertilized biweekly 5 kg. dried blue green algae (*Anabaena spp.*) ($T_4$). Rice fields were prepared with ditches in the middle of the pond with a depth and width of 0.75 x 0.50 m respectively. Screens were fixed at the end of the canals to prevent fish from escaping or the entrance of foreign fishes into rice fields, the growing season for tilapia fish was 90 days.

***Diet preparation:***

A basal diet was formulated to contain 30% crude protein, 8.15% lipids, 6.02% crude fiber, 7.69% ash, and 4.45 Kcal/g diet. Corresponding *Anabaena wisconsinense* culture volume was diluted by distilled water up to 100 ml as a final volume, which was then added to the ingredients of basal diet, which was blended for 40 min at least to make a paste of diet. The pastes were separately passed through a grinder, and pelleted (1 mm diameter ) in a refrigerator (- 2 °C) for further use. Feeding rate of artificial diet was recalculated and adjusted biweekly according to the change in fish biomass as assessed by fish sample. The food pellets were applied once a day for 6 days a week by broadcasting the pond surface near the supply gate.

***Chemical analysis of diets and fish:***

The tested diets and whole-fish body from each treatment at the beginning and at the end of experiment were analyzed according to the standard methods of **A.O.A.C.(1992)** for moisture, protein, fat and ash. Moisture content was estimated by drying the samples to constant weight at 85 °C in drying oven (GCA, model 18EM). Nitrogen content was measured using a microkjeldahl apparatus Labconco (Labconco ,USA) and crude protein was estimated by multiplying nitrogen content by 6.25. Lipid content was determined by ether extraction in multi-unit extraction Soxhlet apparatus for 16 hours and ash was determined by combusting dry samples in a muffle furnace at 550 °C for 6 hours. The experimental diet was chemically analyzed according to the methods of

**A.O.A.C.(1992).** The chemical compositions of experimental diets are presented in Table (1). Live body weight and length of a random sample of 50 fish from each pond were taken at start and every 15 days and were recorded till the termination of the experiment and at the end all fish in each pond were collected.

**Table 1. Chemical analysis of the experimental diets (% on dry matter basis).**

| Ingredients in percentage | Basal diet | *Anabaena wisconsinense* |
|---|---|---|
| Dry matter % DM | 90.78±1.02 | 25.4±0.33 |
| Crude protein % CP | 30.88±0.77 | 62.7±0.89 |
| Ether extract % EE | 8.15±0.15 | 6.2±1.4 |
| Crude fiber % CF | 6.02±0.22 | 5.3±0.06 |
| Ash % | 7.69±1.30 | 8.7±0.41 |
| Nitrogen free extract % NFE* | 47.26±6.33 | 17.1±0.01 |
| Grass Energy ** (Kcal/100g) | 445.3±27.92 | 482.4±15.67 |

***NFE (nitrogen free extract) = 100 – (protein + lipid + ash + crude fiber).**

****GE (gross energy): Calculated according to NRC (1993) as 5.64, 9.44 and 4.11 kcal / g for protein, lipid and NFE, respectively.**

***Water analysis:***

Water samples were collected biweekly at 20 cm depth from each pond, water temperature, dissolved oxygen and pH were measured daily at 6 a.m. and 12 p.m. using temperature and dissolved oxygen meter (YSI model 58) and pH meter (model Corning 345). Determinations of the other water quality parameters (alkalinity, ammonia and phosphorus) were carried out every two weeks according to the methods of **Boyd (1979).** Phytoplankton and zooplankton communities in pond water were determined every month according to the methods described by **Boyd (1990) and A.P.H.A. (1985).** Samples were collected from different sites of the experimental ponds randomly to represent the water of the whole pond.

***Growth performance parameters and data calculation*:**

Growth performance was determined and feed utilization was calculated as following:

Weight gain = final weight – initial weight.

Body weight gain (g/fish) = Mean of weight (g) at the end of the experimental period – weight (g) at the beginning of the experimental period.

Daily weight gain (DWG) = Gain / experimental period.

Relative weight gain (RWG %) = Gain / initial weight X 100

Specific growth rate (SGR%) = (ln $W_1$ – ln $W_0$) / T) X 100

Where $W_1$ is the fish weight at the end (final weight), $W_0$ is the weight at the start (initial weight), ln is the natural log. As described by **Bagenal and Tesch (1978)** and T is the number of days in the feeding period. After 90 days of fish culture, tilapia was harvested from each field and a sample of 30 fish was randomly taken for body weight and body length measures. The rice was harvested after 120 days of sowing.

***Statistical analysis of data:***

Statistical analysis was performed using the Analysis of variance (ANOVA) and Duncan's multiple Range Test, to determine differences between treatments means at significance rate of $P < 0.05$. The standard errors of treatment means were also estimated. All statistics were carried out using Statistical Analysis program **(SAS, 2000).**

## RESULTS AND DISCUSSION

***Water quality parameters*** :

Water quality is an important factor which might affect the growth of fish. The results of water quality parameters of the experimental ponds during the experimental period (90 day) as averages of the monthly samples are summarized in Table (2). There was no significant difference ($P > 0.05$) in water temperature among treatments during the first two weeks, while slightly differences among treatments. The fluctuation in water temperature in the various treatments of ponds during the experiment was caused by fluctuations in air temperature. In general, averages of water temperature ranged from 23.6 through 30.4 °C was favorable for fish culture. **(Boyd, 1990),** referred to the best grow of fish species was at temperature ranged from 20 to 32 °C. **Abdel-Hakim *et al*.,(2000)** found that the optimum temperature ranged between 15- 30 °C for Nile tilapia fish. The concentration of dissolved oxygen (mg/l) in the ponds during the study are listed in Table (2) there were significant differences ($P < 0.05$) among treatments. The highest dissolved oxygen was recorded in treatments $T_3$ and $T_4$ during the experiment may be to due to increasing of phytoplankton and photosynthetic activity. Dissolved oxygen ranged between 6.91 and 8.45 mg/l. These values are beneficial to fish cultivation and indicate that water dissolved oxygen was slightly decreased in fertilized fields compared to the other fields. These results are in agreement with **Boyd, (1992),** who reported that levels of dissolved oxygen above 4ppm is considered a limiting, below which, fish may live but can not feed or grow well. Regarding pH values, it is evident from Table (2). There were significant differences ($P< 0.05$) among treatments during the whole experiment. The pH values in all treatments were always toward the alkaline side, pH ranged between 8.10 and 9.3, the difference of pH values among treatments may be related to increase in primary production which leads to increasing of photosynthesis that involves the uptake of free carbon dioxide from the water **Ellis (1937) and Boyd (1998)** reported that waters with a pH range of 6.5 – 9.30 are the most suitable for fish production. The values of the total alkalinity concentrations were significantly different ($P< 0.05$) among treatments. The values of the total alkalinity ranged between 384.6 and 403.34 mg/l, and total hardness ranged between 242.7 and 271.8 mg/l. The may be related to increase in primary production which lead to increasing of photosynthesis that involving the uptake of free carbon dioxide from the water and precipitation of calcium carbonate **(Boyd 1990).** From the previous results for temperature, dissolved oxygen, pH, total alkalinity and hardness were suitable for fish growth and survival. The average concentration of unionized ammonia ($NH_3$) was 0.41, 0.22,0.29 and 0.21 mg/l for $T_1$, $T_2$, $T_3$ and $T_4$ respectively. Results presented in Table (2) show that the nitrogenous compounds concentration ($NH_3$, $NO_2$, $NO_3$) were significantly different ($P< 0.05$) among treatments. The nitrogenous compounds concentration were higher in $T_3$ (fertilizer) than the other treatments, which may be due to the increase of feces by fish and decomposition phytoplankton or accumulation of nitrogen from the fertilizer in the pond, while tend for lower concentration in the other treatment may be attributed to utilization by phytoplankton, **Rhyne *et al.*, (1985)** refer the consumption of ammonia may be due to algae. The **European Inland Fisheries Adviosory Commission (1993)** reported that the toxic level of $NH_4$ to fish is 2 mg/l. Results presented in Table (2) show that the averages of total phosphorus concentration (TP) were significantly different ($P< 0.05$) among treatments. Averages of TP concentrations ranged between 0.96 and1.89 mg/l. which represent the normal range of phosphorus in rice fish fields, this range was found to be suitable for growth of fish as reported by **Boyd (1992).** Generally, the fluctuation in TP concentrations in water may be related to phytoplankton growth. Thus, content might be consumed by phytoplankton community. Chlorophyll "a" contents in water ponds were more or less related to the total count of phytoplankton in the water. From the results about water quality it could be concluded that the algae (fed diet and fertilizer) affects on water quality parameters, the best suitable for fish growth and survival.

**Table 2. Means concentration of water quality parameters during the experimental period.**

| Parameters | Treatments | | | |
|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| Temperature °C | 25.80A+0.75 | 26.4A±1.32 | 25.66A±1.02 | 25.95A±0.71 |
| Dissolved oxygen (mg/l) | 7.20B+0.08 | 6.91B±0.50 | 8.45A±6.41 | 7.83A±0.11 |
| pH | 8.36AB±2.30 | 9.30A±2.44 | 8.10B±2.30 | 8.46AB±0.75 |
| Total alkalinity (mg/l) | 392.5AB±27.12 | 384.6AB±18.3 | 403.34A±62.2 | 375.7B±12.4 |
| Total hardness (mg/l) | 271.80A±38.1 | 265.5AB±39.2 | 242.70B±14.8 | 258.0AB±51.3 |
| $NH_3$ (mg/l) | 0.41A±0.00 | 0.22AB±0.01 | 0.29AB±0.07 | 0.21B±0.02 |
| $NO_2$ (mg/l) | 0.02A±0.00 | 0.02A±0.00 | 0.03A±0.01 | 0.02A±0.00 |
| $NO_3$ (mg/l) | 0.20B±0.01 | 0.23B±0.5 | 0.32A±0.09 | 0.20B±0.10 |
| Available phosphorus (mg/l) | 0.32B±0.02 | 0.84A±0.06 | 0.27B±0.23 | 0.71AB±0.40 |
| Total phosphorus (mg/l) | 0.96B±0.03 | 1.89A±0.33 | 1.20AB±0.06 | 1.00AB±0.01 |
| Chlorophyll "a" content (µg/l) | 129.0B±52.1 | 194.0A±42.6 | 176.3AB±27.3 | 140.2AB±37.4 |

**Data are represented as mean of three samples replicates ± standard error**
**Means in the same row with the same letter are not significant difference (P>0.05)**

***Phytoplankton:***

As shown in Table (3) the total phytoplankton counts for treatments $T_1$, $T_2$, $T_3$ and $T_4$ were on the average, 731.94, 1687.65, 1126.36 and 1450.77 organisms/ml, respectively. The total phytoplankton counts increased in water samples collected from $T_2$ and $T_4$ were highly significant differences (P< 0.05) for the standing crops of phytoplankton may reflect the better fertilization potential of blue green algae. **El-Fouly *et al.* (1998)** revealed that blue green algae contain 0.28 % (K) and 0.92 % phosphorus which may reflect the better fertilization potential of blue green algae. From these results, they included that a total phytoplankton count in $T_1$ was lower than $T_2$ and $T_4$ so it confirms that high clay turbidity in this treatment resulted in high-limited phytoplankton growth. These results could be explained by the fact that blue green algae decomposition have more fertilization potential compared with other treatments. The present study indicates that *Chlorophyta* (Green algae) was the dominant group followed by *Cyanophyta* (Blue green algae) and Diatoms. **Abdel-Hakim *et al.*, (2000)** reported that *Chlorophyta* predominated all the other groups followed by *Cyanophyta* and *Bacillariophyta* (Diatoms) **Jensen *et al.*, (1994)** pointed out that one of the important reasons why *chlorophytes* were able to out compete blue-green algae in shallow water, no stratified lakes was the continuous input of nutrient from the sediment.

***Zooplankton:***

Table (3) also show that the averages numbers of zooplankton organisms per liter were significantly different ($P< 0.05$) higher in water samples of $T_2$ than the other treatments. The present study indicates that Rotifera is dominating group followed by Ostracods, Cladocera and Copepoda in all fields. This results agree with those of **Kamel *et al.*, (2003)**, indicated that Rotifera was the dominant group in all the treatment ponds. In general, the community composition of phytoplankton and zooplankton in all treatment ponds fluctuated greatly with temperature, fertilization and feeding habits of fish. This community composition of zooplankton is in conformity with observations of **Abdel-Hakim *et al.*, (2000)**.

**Table 3. Effect of different treatments of feeding and fertilizers on plankton groups.**

| Phytoplankton (Organisms/ml) | Treatments | | | |
|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| Green algae (Chlorophyta) | 463.200B±77.9 | 1300.810A±151.2 | 698.000AB±82.1 | 983.002AB±25.7 |
| Blue green algae (Cyanophyta) | 170.500A±38.4 | 127.000B±18.63 | 166.240A±19.4 | 133.123B±4.11 |
| Diatoms | 46.220B±12.67 | 93.670AB±55.38 | 75.120AB±22.3 | 139.611A±47.9 |
| Euglena | 52.020B±45.20 | 165.52A±16.73 | 187.000A±55.9 | 195.034A±92.1 |
| Total | 731.94B±171.1 | 1687.65A±142.8 | 1126.36A±46.2 | 1450.77A±85.8 |
| Zooplankton (organisms/l) | Treatments | | | |
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| Rotifers | 5910.0AB±81.6 | 17112.0A±195.3 | 2608.0B±177.20 | 3515.0AB±245.3 |
| Copepods | 164.0A±63.42 | 135.0AB±23.91 | 91.0AB±37.58 | 39.0B±12.04 |
| Ostracods | 503.0A±57.90 | 785.0A±58.21 | 226.0AB±19.81 | 148.0B±56.40 |
| Cladocerans | 178.0AB±19.70 | 431.0A±11.54 | 185.0AB±18.55 | 71.0B±28.30 |
| Total | 6755AB±149.20 | 18463A±172.81 | 3110B±75.52 | 3773B±334.27 |

**Data are represented as mean of three samples replicates ± standard error**
**Means in the same row with the same letter are not significant difference ($P>0.05$)**

***Growth performance and fish survival:***

Growth performance and fish survival data are illustrated in Table (4). The percentage of survival rate were significant differences ($P< 0.05$) among all treatments. The high rate of survival was recorded in treatments $T_2$ and $T_4$ . The first treatment had the lowest survival percentage 56.11% and the highest survival percentage 89.54% for $T_4$ followed by 81.66 % and 79.83% for $T_2$ and $T_3$ respectively. **El-dahhar *et al.*, (2006)** who found that those 81.65 and 82.07% of mixed-sex tilapia fed on experimental diets in organic fertilized ponds. The growth responses of fish in all the treatments were generally satisfactory. As described in Table (4), the average body weight of Nile tilapia increased from 25.13 to 115.74, 110.30, 90.30 and 78.00 g. for $T_2$, $T_1$, $T_4$ and $T_3$ respectively. It is obvious that $T_2$ (artificial fed diet plus *Anabaena spp.*) recorded higher ($P< 0.05$) final body weight than the other treatments. **Haroon and Pitmen (1997)** who found that, under the integrated rice fish system, the body weight of Nile tilapia increased from 8.3-8.59 to 33.78-36.69 g. during 75 days rice fish culture period, where fields were supplied with inorganic fertilizers. Table (4) also shows that the body length of Nile tilapia increased from 5.54 to 13.70, 14.90, 11.10 and 11.85 cm. for $T_1$, $T_2$, $T_3$ and $T_4$ respectively, after 90 days of culture in rice fields and the values of fish condition factor. The same trend was obtained with regard to total weight gain (TWG), average daily weight gain (DWG), relative weight gain (RWG) and specific growth rate (SGR), these results also showed that there was negative relationship between survival rate and weight gain. The high value of daily gain and the other growth traits found in this study may be attributed to the presence of the natural food organisms enhanced by the fertilization of the paddy environment which served as a direct source of food for Nile tilapia (**Patrona *et al.*, 2004**). **Brown *et al.*, (2000)** indicates that either phytoplankton may not be enough to meet protein requirement of fish or that fish could not efficiently assimilate the produced phytoplankton in these ponds.

**Table 4. Growth performance of Nile tilapia *(Orechromis niloticus)* at rice fish culture treated with different types of feeding inputs and fertilizers.**

| Items | Treatments | | | |
|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| Initial body weight (g/fish) | 25.12 ±0.54 | 25.13 ±1.20 | 25.12 ±0.52 | 25.12 ±1.51 |
| Final body weight (g/fish) | 110.3A ±43.0 | 115.74A ±21.84 | 78.00B ±12.30 | 90.30 B±23.10 |
| Initial body length (cm/fish) | 5.54±0.20 | 5.54±0.22 | 5.54±0.71 | 5.54±0.02 |
| Final body length (cm/fish) | 13.7A±0.41 | 14.9A±0.63 | 11.10B±1.20 | 11.85B±0.49 |
| Total weight gain (g/fish) (TWG) | 85.24A±14.35 | 90.61A±0.89 | 52.88B±17.30 | 65.18B±1.38 |
| Daily weight gain (g/day/fish) (DWG) | 0.94AB±0.06 | 1.6A±0.04 | 0.58±B0.08 | 0.72B±0.07 |
| Relative weight gain (RWG%) | 339.3A±86.10 | 360.5A±47.35 | 210.5B±66.20 | 259.5AB±68.41 |
| Specific growth rate (SGR%) | 1.6A±0.07 | 1.7A±0.08 | 1.25B±0.90 | 1.40B±0.03 |
| Survival rate (%) | 56.11B±0.59 | 81.66A±46.55 | 79.83AB±23.49 | 89.54A±45.30 |

**Data are represented as mean of three samples replicates ± standard error**
**Means in the same row with the same letter are not significant difference (P>0.05)**

***Economic efficiency:***

Table 5. shows the results of economical evaluation including the costs and returns for treatments applied in Kg/ feddan and income in (L.E) for 90 days. All of the treatments in this experiment generated a profit (Table 5 ). Total costs were 2360,1910,1915 and 1760 L.E / feddan for $T_1$, $T_2$, $T_3$ and $T_4$ respectively. These results revealed that the total cost of $T_1$ ( diet with 30% protein) was the highest than other treatments. On the other hand, the total cost of $T_4$ (fertilized with *Anabaena wisconsinense*) was the lowest due to the absence of input costs. Net returns in L.E per feddan were1268.35, 1992.75,1611 and 1743.75 for $T_1$, $T_2$, $T_3$ and $T_4$ respectively. Percentages of net return to total cost were 53.74%,104.33%,95.92% and 99.07 % for $T_1$, $T_2$, $T_3$ and $T_4$ respectively, indicating that the highest returns were obtained with the second treatment ($T_2$), followed by $T_4$ and $T_3$ while the lowest net return was $T_1$.

**Table 5. Economic efficiency (%) of Nile tilapia *(Orechromis niloticus)* fingerlings production as affected by the applied treatments during the experimental period for 90 days in L.E./feddan.**

| Items | Treatments | | | |
|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| (A) Stocking data | | | | |
| Stoking rate of tilapia (fish/feddan) | 1200 | 1200 | 1200 | 1200 |
| Average size at stoking of tilapia (g/fish) | 25.12 | 25.13 | 25.12 | 25.12 |
| Average size at harvesting of tilapia (g/fish) | 110.36 | 115.74 | 78.00 | 90.30 |
| Survival rate % | 56.11 | 81.66 | 79.83 | 89.54 |
| Production, Kg/feddan of tilapia | 105.670 | 120.550 | 75.200 | 72.750 |
| Production, Kg/feddan of rice | 3100 | 3300 | 3150 | 3140 |
| (B) Operating costs (L.E.) | | | | |
| Fish fingerlings | 360 | 360 | 360 | 360 |
| Commercial diet (30% protein) | 1200 | 600 | — | — |
| Rice seeds | 100 | 100 | 100 | 100 |
| Fertilization | ----- | ---- | 755 | --- |
| Algae (dried *Anabaena spp*) | ----- | 150 | ---- | 600 |
| Labor (one / feddan) | 300 | 300 | 300 | 300 |
| Land renting | 400 | 400 | 400 | 400 |
| Total costs / feddan (L.E.) | 2360 | 1910 | 1915 | 1760 |
| (C) Returns | | | | |
| Rice (L.E.) | 3100 | 3300 | 3150 | 3140 |
| Fish (L.E.) | 528.35 | 602.75 | 376.00 | 363.75 |
| Total Returns / feddan (L.E.) | 3628.35 | 3902.75 | 3526.0 | 3503.75 |
| Net returns (L.E.) | 1268.35 | 1992.75 | 1611.00 | 1743.75 |
| % Net returns to total costs | 53.74 | 104.33 | 95.92 | 99.07 |

**The economical evaluation of results was carried out according to market prices in 2008 in L.E. where: 1000 tilapia fingerlings 15-18g each = 260 L.E. 1000 tilapia fingerlings 20-25g each = 300 L.E.**

In conclusion, based on the obtained results and the high cost of fertilization and fish diet now, it recommended that, the use of dried *Anabaena spp.* in fish ponds culture for producing Nile tilapia fingerlings.

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## استخدام طحلب الانابينا كعامل تسميد حيوى وغذاء لاستزراع اسماك البلطى النيلى فى حقول الارز

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أجريت هذه التجربة لدراسة القيمة الغذائية ومعدلات النمو والانتاجية الكلية والكفاءة الاقتصادية لاستخدام بعض الطحالب الخضراء المزرقة ( طحلب الانابينا ) بعد ان تم تنميته على نطاق واسع داخل وخارج المعمل تحت الظروف البيئية المصرية لكى يستخدم كنوع من التسميد العضوى biofertilization والغذاء لاسماك البلطى النيلى المرباة فى حقول الارز ، حيث تم استخدام ثمانية أحواض مساحة الحوض واحد فدان زرعت بالارز وتم تسكين أصبعيات البلطى النيلى بمعدل ١٢٠٠ /فدان بمتوسط وزن أولى ٢٥جم . وقسمت الى أربعة

معاملات وهى كالآتى : المعاملة الاولى ($T_1$ ) التغذية على عليقة أسماك صناعية ٣٠% بروتين ومحتوى الطاقة ( ٤٤٥ كيلو كالورى/ ١٠٠ جم عليقة ) بمعدل ٥% من وزن الجسم (٥ أيام / أسبوع ) ، المعاملة الثانية ($T_2$ ) استخدمت فيها الطحالب الخضراء المزرقة (طحلب الانابينا) المجففة بنسبة احلال ٥٠% من وزن العليقة الصناعية المقدمة للاسماك بمعدل ٥% من وزن الجسم (٥ أيام / أسبوع) ، المعاملة الثالثة ($T_3$) التسميد بسلفات الامونيوم بمعدل ٧,٥ كجم/ أسبوع ، و المعاملة الرابعة ($T_4$) التسميد بالطحالب الخضراء المزرقة المجففة ( طحلب الانابينا ) بمعدل ٥ كجم/ أسبوع ، وقد تم تكرار كل معاملة مرتين واستمرت الدراسة لمدة ٩٠ يوما ، وكانت النتائج كالتالى:

١- أتضح ان أعلى متوسط نمو يومى ممثل فى مقاييس الجسم (وزن – طول) وكذلك الوزن النهائي تم تسجيلها لاسماك المعاملة الثانية ($T_2$ )، بينما كان أعلى معدل اعاشة تم الحصول عليه كان في اسماك المعاملة الرابعة ($T_4$) .

٢- أظهرت النتائج زيادة الانتاج الكلى و التكاليف الكلية كانت فى المعاملة الاولى ($T_1$) والثانية ($T_2$ )، بينما كان عائد الربح الصافى فى المعاملة الثانية ($T_2$) أعلى من كل المعاملات التى أجريت فى هذا البحث.

ولذلك توصى هذه الدراسة باستخدام الطحالب الخضراء المزرقة ( طحلب الانابينا ) فى المزارع السمكية كتغذية للاسماك او كتسميد عضوى وذلك للحصول على أفضل وسط بيئى لنمو الاسماك ، أعلى انتاجية وأعلى كفاءة اقتصادية ( من حيث صافى الربح ) لانتاج الاسماك خاصة مع ارتفاع اسعار العلف والاسمدة الموجودة حاليا.

# INFORMATION

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