Evaluation of phytoplankton diversity in periphyton based aquaculture system

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Abstract

This study was done to determine the impact of rice straw as a substrate for periphyton production and phytoplankton biodiversity in earthen fish ponds belongs to the world fish center. The ponds have the same area of Six 1000 m^2 and the depth of water 1m. The ponds cultured with mono six Nile tilapia fry in the rate of 3 fry/ m^2. All ponds were fertilized with dry chicken manure in the rate of 15 kg/pond/week, and divided into two treatments, each of 3 replicates; the first treatment (T1), the substrate free control, while second treatment (T2) received 45 kg dry rice straw/pond. The samples were collected monthly from May to December 2017. The quantitative measurements for phytoplankton showed that total count of phytoplankton in water was higher in T1 than T2. The rice straw was effective for controlling growth of cyanophyceae compared to controls, and was capable for inhibiting the growth of *Microcystis*. *Phormidium*, *Merismopediam*, *Gloeocapsa*, *Lyngbya and Chlorella*, but *Chrococcus*, *Synedra* and *Navicula* sp. had improved growth in the presence of rice straw. Concerning periphyton the total count was (2103.68 x 10^6 org. /m^2 as an average). And Chlorophyceae represent the dominant group with average (1577.07 x 10^6 org. /m^2). The biodiversity index of overall phytoplankton genera Taxa evenness were (1.95 and 0.51) respectively in T2 which indicates that there is a high biodiversity of algae compared to T1 (1.76 and 0.42). The results of this investigation indicated that rice straw could introduce an accessible practical and commercial method to increased phytoplankton biodiversity.

Key words: Diversity, earthen fish ponds, periphyton, phytoplankton, Rice straw, Nile Tilapia.

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Introduction

Periphyton based aquaculture system generated a lot of importance in recent years (**Tidwell *et al*., 2000**). Various materials like tree branches (**Hem and Avit, 1994**), plastic (**Shrestha and Knud-Hansen, 1994**), split bamboo (Faruk-ul-Islam, 1996), rice straw (**Mridula *et al*., 2003, 2005**), kanchi (**Wahab *et al*., 1999; Azim *et al*., 2003a**), bamboo (**Azim *et al*., 2003b**) have been used as substrate in periphyton based aquaculture system. Rice straws; however, is widely available in the farm in South Asia because it is widely cultivated in this region. It is a low cost material and has low nutritive value (**Potikanond *et al*., 1987**). Farmers often burn them in the field instead of using wisely in the fish ponds that may pollute the environment. Rice straw can be used in fish ponds to mitigate turbidity (**Yi *et al*., 2003**), and to develop periphyton (**Mridula *et al*., 2003, 2005**) that eventually enhance the fish production. Periphyton-based culture exemplifies suitable natural food source for fish production (**Hem and Avit, 1994**) and performs better than the traditional substrate–free systems. Periphyton-based systems recommend the potential for improving natural food as well as nutrient efficiency for higher fish output in enclosed culture systems. Phytoplankton is the primary producers in several aquatic systems (**Gupta and Dey, 2012**). Besides its role in providing the food for aquatic animals, it also plays a vital role in maintaining the biological balance and quality of water (**Benarjee and Narasimha, 2013**).

Relations between species diversity and various environmental gradients give a distinctive challenge to models of community composition. Attached algae and plankton are main part of energy fixation (**Periyanayagi *et al*., 2007**). Energy demand of herbivorous carps and tilapia cannot be satisfied only by plankton they also need larger benthic algae, algal detritus or plant fodder, that can be harvested more efficiently (**Hossain *et al*., 2007**). These types of algae can be grown in the substrates so that fish can harvest them efficiently (**Van Dam *et al*., 2002**). Therefore, present experiment was conducted to investigate effects of rice straw on periphyton production and phytoplankton biodiversity in earthen fish ponds.

Materials and Methods

This experiment was conducted in earthen ponds belongs to the world fish center. The ponds have the same area of Six 1000 m^2. The ponds received fresh water from El-Ismailia canal which occasionally mixed with well water and cultured with mono six Nile tilapia fry in the rate of 3 fry/ m^2. All ponds were fertilized with dry chicken manure in the rate of 15 kg/pond/week, which divided into two treatments, each of 3 replicates; the first treatment (T1), the substrate free control, while second treatment (T2) received 45 kg dry rice straw/pond. Rice straw was in the form of bundles; which suspended from vertical pillars which established along the pond sides. The experiment periods extended from May to December .

Phytoplanktons

One liter of water was collected monthly from the different treatment in polyethylene bottles. Phytoplankton was concentrated by settling 500 ml sample in a volumetric cylinder for about 24 hours after being kept in lugols̊ solution (**APHA, 1985**). The surface water was siphoned and the sediment was examined. One ml of sample was transferred into Sedgwick-Rafter cell and counted microscopically. Different algal species were identified according to **Boyd and Tucker (1992).**

Plankton species diversity was determined using the diversity index formula of **Shannon and Weaver (1949):** $H' = -\sum(Ni/N) \times \ln(Ni/N)$. Where

ni = number of individuals of each species.

N = total number of individuals.

Maximum diversity is given by: $Hmax = \ln S$

S is the total number of species.

The evenness (E) was calculated by comparing the actual diversity to this maximum diversity where

E = H'\Hmax.

Periphyton samples

Periphyton samples were collected monthly. Pieces of rice straw was cut from three different depths and wrapped in aluminum foil for periphyton analysis. Each sample was transferred to an Erlenmeyer flask containing 50 ml distilled water and shaken in mechanical shaker for 3 h to separate periphytons from the straw. Samples were kept in 6% formalin solution **(Michael, 1984**). Periphytons were counted using Sedgwick-Rafter cell and counted microscopically. The number of periphyton units was estimated by the formula:

Where:

Number of periphyton units

Number of periphyton units counted in ten random fields of S-R cell

Volume of final concentrated sample (mL)

Area of rice straw (cm^2)

Interpretation of Results: For interpreting the observed data, phytoplankton genera and algal periphyton genera were used for categorization of the water bodies according to **APHA (1989) (Table 1):**

Filter Clogging Algae: *Closterium, Tabellaria, Navicula, Cyclotella, Chlorella, Synedra, Anabaena, Palmella, Diatoma, Chrococcus* and *Flagilaria.*

Taste and Odor Algae: *Anabaena, Hydrodictyon, Synedra, Peridinium, Volvox, Tabellaria, Staurastrum, Aphanizomenon, Anacystis, Ceratium* and *Nitella*.

High Organic Load (Polluted Water) Algae: *Phormidium, Nitzschia, Tetraedron, Anabaena, Spirogyra, Oscillatoria, Phacus, Merismopedia, Gloeocapsa, Lyngbya, Chlorella* and *Euglena*

Clear Water Algae: *Cyclotella, Navicula, Flagilaria, Ankistrodesmus, Cladophora* and *Lemanea Hildenbrandia, Surirella, Calothrix,* and *Cocconeis*

Table (1): phytoplankton genera and algal periphyton genera classification according to APHA (1989).

Classification	Genus	Classification	Genus
Filter Clogging Algae	*Closterium*	Taste and Odor Algae	*Anabaena*
	Tabellaria		*Hydrodictyon*
	Navicula		*Synedra*
	Cyclotella		*Peridinium*
	Chlorella		*Volvox*
	Synedra		*Tabellaria*
	Anabaena		*Staurastrum*
	Palmella		*Aphanizomenon*
	Diatoma		*Anacystis*
	Chrococcus,		*Ceratium*
	Flagilaria		*Nitella*
Classification	**Genus**	**Classification**	**Genus**
High Organic Load (Polluted Water) Algae	*Phormidium*	Clear Water Algae	*Cyclotella*
	Nitzschia		*Navicula*
	Tetraedron		*Flagilaria*
	Anabaena		*Ankistrodesmus*
	Spirogyra		*Cladophora*
	Oscillatoria		*Ulothrix*
	Phacus		*Cladophora*
	Merismopedia		*Lemanea*
	Gloeocapsa		*Hildenbrandia*
	Lyngbya		*Surirella*
	Chlorella		*Calothrix*
	Euglena		*Cocconeis*

Results and Discussion

The total number of identified and recorded phytoplankton species at different treatments during the period of study is presented in Tables (2, 3, 4 and 5). A total of 23 taxa, belonging to three classes namely; Chlorophyceae (n=12), Cyanophceae (n=7), and Bacillariophyceae (n=4) were found in the source of water, and in the first treatment (control) a total of 28 taxa, belonging to three classes namely; Chlorophyceae (n=17), Cyanophyceae (n=8), and Bacillariophyceae (n=3) were found, while in the second treatment (rice straw) A total of 24 taxa, belonging to three classes namely; Chlorophyceae (n=14), Cyanophyceae (n=6), and Bacillariophceae (n=4) were found. A total of 27 taxa, belonging to three classes namely; Chlorophyceae (n=14), Cyanophyceae (n=7), and Bacillariophyceae (n=6) were found in the source of water. From above results it was clear that Chlorophyceae was the most highly diverse group and this result agree with (**Hanaa *et al*., 2014**).

Distribution and monthly variations

Regarding the distribution and monthly variations, the total counts of phytoplankton showed maximum existence in the source of water and T1 recorded in august, and the maximum count in T2 was observed in October while in T3 the maximum count was found in November and the minimum count was recorded in May in all the different treatment. The maximum count of phytoplankton was recorded at T1 (62.15 x 10^6 org. /L as an average), followed by T2 (46.12 x 10^6 org. / L as an average). Then the total phytoplankton abundance in control treatment (without rice straw) more than other treatment (with rice straw), this may be due to inhibitory effect of rice straw on phytoplankton in the pond ecosystem because it may be release phenolic compounds that a have a synergistic effect on phytoplankton growth (**Shahabuddin *et al.*, 2012**), while the least number occurred at the source (4.82 x 10^6 org. / L as an average).

Concerning the phytoplankton classes, it is clear that Cyanophyceae are the most dominant group of phytoplankton in the source of water, T1 and T2 with average numbers (2.29, 50.6 and 35.4 x 10^6 org. / L) respectively. The shift in algal composition of treated ponds form cyanobacteria to chlorophyceae might be useful in control of toxic cyanobacterial species such as ichthyotoxic species *Microcystes* (**Geng *et al*., 2006; Wu *et al*., 2007**). Besides, it provides important information that rice straws could probably be used as a management strategy for improvement of water quality in water bodies.

Table (2): Maximum, mean abundance; frequency of occurrence and Composition of phytoplankton genus in the source of water

Division	Genus	Maximum (Monthly abundance)	Mean	Frequency	Composition
Chlorophyceae	*Chlorella*	December	0.231	13.051	4.792
	kirchneirella	December	0.206	11.667	4.284
	Tetraedron	November	0.016	0.905	0.332
	Scenedesmus	November	0.153	8.668	3.183
	Closterium	December	0.450	25.465	9.351
	Tetrastrum	July	0.030	1.7058	0.626
	Pediastrum	July	0.041	2.334	0.857
	Volvox	August	0.202	11.395	4.184
	Coelastrum	August	0.052	2.9673	1.089
	Selenastrum	July	0.010	0.558	0.205
	Monoraphidium	June	0.064	3.591	1.318
	Palmella	September	0.313	17.686	6.494
	Total	**December**	**1.768**	**100**	**36.711**
Cyanobacteria	*Anabena*	July	0.118	5.137	2.443
	Lyngbya	August	1.501	65.543	31.177
	Merismopedia	September	0.280	12.236	5.820
	Microcystis	August	0.070	3.054	1.452
	Gloeocapsa	September	0.036	1.585	0.754
	Chrococcus	June	0.254	11.084	5.272
	Phormidium	July	0.031	1.3587	0.646
	Total	**August**	**2.291**	**100**	**47.571**
Bacillarophyceae	*Cyclotella*	November	0.017	13.658	0.360
	Synedra	December	0.080	62.855	1.657
	Cymatopleura	July	0.021	16.634	0.438
	Navicula	May	0.009	6.829	0.180
	Total	**July**	**0.127**	**100**	**2.637**
Euglenophyceae	**Total Eug.**	**September**	**0.630**	**100**	**13.081**
Total count		**August**	**4.816**		

Table (3): Maximum, mean abundance; frequency of occurrence and Composition of phytoplankton genus in treatment (1).

Division	Genus	Maximum (Monthly abundance)	Mean	Frequency	Composition
Chlorophyceae	*Chlorella*	August	1.364	13.973	2.195
	kirchneirella	December	0.518	5.309	0.834
	Tetraedron	October	0.199	2.042	0.321
	Scenedesmus	October	4.405	45.108	7.088
	Closterium	December	1.152	11.795	1.853
	Tetrastrum	August	0.531	5.439	0.854
	Pediastrum	November	0.061	0.633	0.099
	cosmarium	May	0.007	0.074	0.0116
	Tetradrom	November	0.110	1.126	0.177
	Coelastrum	August	0.049	0.507	0.079
	Selenastrums	September	0.152	1.559	0.245
	Volvox	August	0.488	5.004	0.786
	Monoraphidium	July	0.436	4.467	0.701
	crucigenia	July	0.028	0.293	0.046
	Treubaria	July	0.014	0.146	0.023
	Dictyosphaerium	July	0.034	0.354	0.055
	Palmella	September	0.211	2.1635	0.339
	Total	**October**	**9.767**	**100**	**15.714**
Cyanobacteria	*Anabena*	November	0.968	1.910	1.558
	Lyngbya	August	42.587	84.004	68.518
	Merismopedia	September	5.310	10.475	8.544
	Microcystis	October	0.798	1.575	1.285
	Phormidium	December	0.025	0.0495	0.040
	Gloeocapsa	September	0.055	0.109	0.089
	Chrococcus	November	0.942	1.859	1.517
	Spirulina	May	0.007	0.014	0.011
	Total	**August**	**50.696**	**100**	**81.565**
Bacillarophyceae	*Synedra*	December	0.154	49.399	0.247
	Navicula	September	0.076	24.553	0.123
	Cymatopleura	August	0.081	26.046	0.130
	Total	**August**	**0.311**	**100**	**0.500**
Euglenophyceae	**Total Eug.**	**December**	**1.378**	**100**	**2.217**
Total count		**August**	**62.154**		

Table (4): Maximum, mean abundance; frequency of occurrence and Composition of phytoplankton genus in treatment (2).

Division	Genus	Maximum (Monthly abundance)	Mean	Frequency	Composition
Chlorophyceae	*Chlorella*	December	0.545	6.205	1.182
	kirchneirella	November	0.410	4.661	0.888
	Tetraedron	November	0.210	2.392	0.455
	Scenedesmus	October	3.693	42.028	8.008
	Closterium	December	1.512	17.205	3.278
	Tetrastrum	September	0.640	7.283	1.387
	crucigenia	July	0.008	0.095	0.018
	Volvox	September	1.072	12.200	2.324
	Monoraphidium	October	0.393	4.473	0.852
	Dictyosphaerium	September	0.009	0.101	0.019
	selenastrums	October	0.103	1.171	0.223
	Treubaria	August	0.040	0.455	0.086
	Palmella	December	0.112	1.270	0.242
	Coelastrum	August	0.040	0.455	0.086
	Total	**September**	**8.787**	**100**	**19.054**
Cyanobacteria	*Anabena*	July	1.535	4.332	3.328
	Lyngbya	August	29.020	81.906	62.929
	Merismopedia	September	3.096	8.739	6.714
	Microcystis	October	0.579	1.634	1.255
	Gloeocapsa	June	0.028	0.079	0.060
	Chroococcus	December	1.172	3.306	2.540
	Total	**August**	**35.430**	**100**	**76.829**
Bacillarophyceae	*Cyclotella*	November	0.027	6.243	0.059
	Synedra	November	0.199	45.516	0.430
	Cymatopleura	September	0.085	19.447	0.184
	Navicula	June	0.126	28.792	0.272
	Total	**November**	**0.436**	**100**	**0.945**
Euglenophyceae	**Total Eug.**	**December**	**1.461**	**100**	**3.168**
Total count		**October**	**46.115**		

Table (5): Maximum, mean abundance; frequency of occurrence and Composition of periphyton in terms of the pond surface area in the rice straw treatment.

Division	Genus	Maximum (Monthly abundance)	Mean	Frequency	Composition
Chlorophyceae	*Pediastrum*	August	4.776	0.302	5.071
	Chlorella	December	208.600	13.227	9.915
	Kirchneirella	December	46.504	2.948	2.210
	Tetraedron	December	38.194	2.421	1.815
	Scenedesmus	September	375.951	23.838	17.871
	Closterium	November	379.077	24.036	18.019
	Tetrastrum	September	46.904	2.974	2.229
	Cosmarium	December	18.348	1.163	0.872
	Selenastrums	September	5.375	0.340	0.255
	Volvox	November	331.755	21.036	15.770
	Monoraphidium	November	45.484	2.884	2.162
	Palmella	November	10.474	0.664	0.497
	Dictyosphaerium	September	2.845	0.180	0.135
	Coelastrum	August	62.777	3.980	2.984
	Total	**November**	**1577.070**	**100**	**74.967**
Cyanobacteria	*Anabena*	December	10.520	3.019	0.500
	Lyngbya	September	89.307	25.634	4.245
	Merismopedia	November	97.303	27.929	4.625
	Phormidium	September	40.176	11.531	1.909
	Microcystis	September	7.378	2.118	0.350
	Gloeocapsa	September	8.637	2.479	0.410
	Chroococcus	November	95.065	27.287	4.518
	Total	**September**	**348.388**	**100**	**16.560**
Bacillarophyceae	*Cyclotella*	November	2.376	2.856	0.112
	Synedra	November	15.662	18.828	0.744
	Navicula	November	46.880	56.357	2.228
	Cymatopleura	August	2.615	3.144	0.124
	Nitzschia	September	2.361	2.839	0.112
	Tabellaria	December	13.287	15.974	0.631
	Total	**November**	**83.184**	**100**	**3.954**
Euglenophyceae	**Total Eug.**	**December**	**95.037**	**100**	**4.517**
Total count		**November**	**2103.681**		

Concerning species composition and frequency, it is clear that *Closterium* and *Palmella* sp. were the dominant genus among Chlorophyceae in the source with average number (0.451 and 0.313 x 10^6 org./L) respectively, and the *Scenedesmus* sp. was the dominant genus among Chlorophyceae in T1 and T2 with average number (4.40 and 3.69 x 10^6 org./L) respectively, While among Cyanophyceae it is clear that, the most dominant genus was *Lyngbya* with an average number (1.50, 42.58 and 29.02 x 10^6 org./L) in the source, T1 and T2 respectively, and among Bacillarophyceae, the *Cymatopleura* is the most dominant genus with an average number (0.021 x 10^6 org./L) in the source, and the *Synedra* is the most dominant genus in T1 and T2 with an average number (0.154 and 0.199 x 10^6 org./L) respectively. The rice straw inhibited the growth of some polluted algae common in fresh water such as *Phormidium*, *Merismopediam, Gloeocapsa, Lyngbya and Chlorella*, however, *Chrococcus*, *Synedra* and *Navicula* sp. had improved growth in the presence of rice straw.

Periphyton is the total assemblage of attached aquatic flora and fauna that are more easily consumed by fish. In usual fish ponds, as in the case of the substrate free control, the pond bottom presents the only substrate for benthic algae to grow (**Azim *et al.*, 2003b**). Apparently this produces less food to meet the requirements of most culture species. However, rice straw as additional substrates, provide more algae which provide natural food to increase fish yield. The periphyton community constitutes a main factor of aquatic biological systems; it includes both the phyto-perithyton and zoo-periphyton and sometime aquatic insects (**Biggs, 1987**). In the present work, phyto-periphyton only recorded as periphyton.

The periphyton community was composed of Chlorophyceae, which includes 17 taxa (*Chlorella*, *kirchneirella*, *Tetraedron*, *Scenedesmus*, *Closterium*, *Tetrastrum*, *Pediastrum*, *Volvox*, *Coelastrum*, *Selenastrum*, *Monoraphidium*, *Palmella*, *cosmarium*, *Tetradrom ,crucigenia*, *Treubaria* and *Dictyosphaerium*), Cyanophyceae, was composed of 8 taxa (*Anabena*, *Lyngbya*, *Merismopedia*, *Microcystis*, *Phormidium*, *Gloeocapsa*, *Chrococcus* and *Spirulina*) and Bacillariophyceae which represented by 6 taxa namely; *Cyclotella*, *Synedra*, *Navicula*, *Cymatopleura* , *Nitzschia* and *Tabellaria.* The total count of periphyton was (2103.68 x 10^6 org. /m^2 as an average). And Chlorophyceae represent the dominant group with average (1577.07 x 10^6 org. / m^2). The *Closterium and Scenedesmus* sp. were the dominant genus among Chlorophyceae with average number (379.07x10^6 and 375.95 x10^6 org./ m^2) respectively while *Merismopedia* was the most dominant genus among Cyanophyceae with an average number (97.30×10^6 org./ m^2) and the *Navicula* is the most dominant genus among Bacillariophyceae with an average number (46.88×10^6 org./ m^2). (Table 5)

Further, it was again confirmed by the analysis of phytoplankton and algal periphyton genera as per APHA (1989) as mentioned in the methodology, the rice straw inhibited the growth of some toxic algae common in fresh water, where the T1 was categorized under the organic load water algae compared to T2 (Tables 2 to 5).

The biological diversity was measured by Shannon and Weaver diversity index (H^-) and evenness. Diversity is dependent on key environmental processes such as predation, competition, and succession; consequently changes in these processes can alter the species diversity index throughout changes in evenness (**Stirling and Wilsey, 2001**). A community dominated by one or two species is considered to be less diverse than one in which several different species have a similar abundance. Usually the value of the index ranges from 1.5 (low species richness and evenness) to 3.5 (high species evenness and richness) (**Shannon, 1948**).

The biodiversity index of overall phytoplankton genera taxa evenness were (1.95 and 0.51) respectively in T2 which indicates that there is a high biodiversity of algae compared to T1 (1.76 and 0.42) which indicates that the rice straw increased phytoplankton biodiversity, while the diversity and taxa evenness in periphyton were (2.18 and 0.28) which indicates that there is a high biodiversity of algae and that the number of species is unequally distributed among algae taxa **(Fig. 1).**

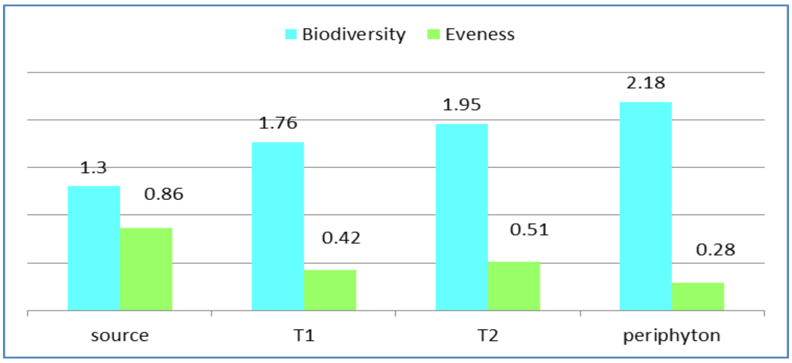

Fig. 1. Evenness and diversity of phytoplankton and periphyton at different treatment

Conclusion

From the results of the present investigation, it could be concluded that the use of rice straw in earthen fish ponds to produce sufficient quantity of phytoplankton and periphyton for fish pond management is better and safe and application of rice straw reduce growth of some toxic algae widespread in fresh water.

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تقييم التنوع البيولوجي للهائمات النباتية الملتصقة علي المادة البادئة

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1- المعمل المركزي لبحوث الثروة السمكية- العباسة- ابو حماد- الشرقية
2- المركز الدولي للأسماك- العباسة- ابوحماد- الشرقية

تأثير قش الأرز كمادة بادئة لتكوين الهائمات الملتصقة علي التنوع البيولوجي للهائمات النباتية في أحواض الأسماك الترابية. أجريت هذه الدراسة لبيان تاثير قش الارز علي انتاج بادئات النمو والتنوع البيولوجي للهائمات النباتية في الاحواض السمكية وتم استحدام ستة احواض ترابية، تبلغ مساحة كل منها حوالي 1000م^2 وعمق المياه حوالي 1م. وتم استزراع الاحواض بالبلطي النيلي وحيد الجنس بمعدل 3 اصبعيات/ م^2 وتم التسميد بزرق الدواجن بمعدل 15 كجم حوض اسبوعيا. وقد قسمت هذه الاحواض الي مجموعتان كل مجموعة بثلاث مكررات. احداهما مجموعة ضابطة لم يتم اضافة قش الارز اليها (كنترول). والاخري تم وضع قش الارز بمعدل 45جم/ م^{2}وتم وضع القش بمحازاة الضلعان الطويلان للاحواض لتعمل كركائز لتحفيز نمو الهائمات النباتية الملتصقة عليها واستمرت فترة التجربة طوال موسم الاستزراع بداية من شهر مايو وحتي شهر ديسمبر وتم اخذ عينات لكل من الهائمات النباتية الحرة والملتصقة شهريا. وأظهرت النتائج أن العدد الكلي للهائمات النباتية في المجموعة الضابطة أكثر من المجموعة المضاف اليها قش الأرز . وكانت الطحالب الخضراء المزرقه هي الاكثر سيادة في مياه المصدر والمعاملة الاولي والثانية وأوضحت النتائج أن قش الارز له تأسير مثبط لنمو بعض أنواع من الطحالب الخضراء المزرقه مقارنه بالمعاملة الاولي مثل الميكروسيست، الفرمديم، المريسموبديم، الجاليوكابسا، اللنبيا والكلوريلا بينما بعض الانواع الاخري مثل الكروككيس، السيندرا والنفكيولا تحسن من نموها في وجود قش الارز. أما فيما يتعلق بالهائمات الملتصقة, فكان العدد الكلي حوالي (2013.68 × 10^6 كائن/ م^2) وكانت رتبة الطحالب الخضراء هي الاكثر سيادة (1577 × 10^6 كائن/ م^2) وكذلك أظهرت النتائج أن الكلوستيريم والسيندسمس هي الأنواع الأكثر انتشارا في رتبة الطحالب الخضراء بمتوسط قدره (379.07× 10^6 375.95 × 10^6 كائن/ م^2) علي التوالي بينما كان المريسموبديم الاكثر سيادة في رتبة الطحالب الخضراء المزرقه بمتوسط قدره (97.30× 10^6 كائن/ م^2) والنفكيولا هي الاكثر وجودا في الديتوم بمتوسط قدره (46.88 × 10^6 كائن/ م^2). وكذلك أوضحت النتائج أن المعاملة الثانية هي الأكثر تنوعا في الطحالب مقارنة بالمعاملة الأولي.

من النتائج السابقة يمكن استخدام قش الارز في المزارع السمكية كطريقة تجارية وامنة لزيادة التنوع البيولوجي للهائمات النباتية الحرة والملتصقة وكذلك له دور مهم في تثبيط نمو بعض الأنواع الضارة من الطحالب المنتشرة في المياه العذبة.