INTEGRATED MANAGEMENT OF FISH (NILE TILAPIA) AND LEAF VEGETABLE CROP (HEAD LETTUCE) CULTURE UNDER DRIP IRRIGATION SYSTEM

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ABSTRACT

Effluent of fish farms is considered a safe source for irrigation and fertigation in the same time. A field experiment took place on Horticulture research farm, Faculty of Agricultural, Kafr El-Sheikh University, north of the Nile Delta, Egypt, having a clay textured soil during winter growing seasons of 2015/2016 and 2016/2017to study the effect of utilization of fish effluent on lettuce production and emitters performance under drip irrigation system. The drip irrigation system was studied at three different emitter types: long path flow, in-line type and 4 l h^{-1} discharge (D1); turbulent flow, on-line type and 6 l h^{-1} discharge (D2) and laminar flow, on-line type and 4 l h^{-1} discharge (D3), three levels of recommended N dose: 100% N, 75% N and 50% N and two different sources of irrigation water: traditional irrigation water (IW) and drainage water of fish ponds (FW). Traditional irrigation water was applied at 100% N only. Main results cleared out that, FW increased clogging ratio comparing with IW for different emitter types, D3 emitter had the highest clogging ratio while D2 emitter had the lowest; application uniformity at end of the growing season decreased comparing with it at beginning for all treatments, FW decreased Cu at end of the growing season comparing with IW; FW enhanced lettuce yield comparing with IW for different treatment, where FW increased total head yield by 51.2, 50.2 and 61.3% for D1, D2 and D3 respectively comparing with IW under 100% N level; FW increased water and nitrogen productivity comparing with IW for different treatments. Weight gain during feed period values were 52.95 and 52.42 g at the technique of water exchange and traditional treatment respectively.

Keywords: *management, integrated culture, fish effluent, drip irrigation*

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1.INTRODUCTION

The world is facing a hard problem of water scarcity, thus, drainage water reuse is gaining attention because it is an option to increase available water supplies. The drainage water of fish farms is considered an alternative safety source of irrigation and nitrogen throughout the season, where the immoderate use of mineral nitrogen fertilizers excess the major cost in crop production and creates degradation for the agricultural environment moreover affects the soil fertility. Using drainage water of fish farms for green-leaf crop leads to the availability of a continuous source of nitrogen during all stages of growth helps in the continuous growth without interruption as this has a positive effect on the quality attributes. The lettuce is rich in vitamins and minerals which are highly required for human health, it is cultivated and consumed by the whole world and its production exceeded 24 million tons in 2014 **(FAO Fish. Aquac. Dep. Rome, 2014)**, in Egypt it is most often grown as a green-leaf crop most popular among the salad crops **(Farrag et al., 2016) .**

(Nhan et al., 2008) stated that only 5-6% of the total imports of N, OC or P in the ponds were harvested from harvested fish. About 29% of N, 81% of OC and 51% of P gathered in the sediments. The remaining parts have been lost by emptying the ponds in adjacent channels. The performance of the fish and the accumulation of nutrients in the sediments increased with a larger contribution of nutrients to the pond at the expense of a larger discharge of nutrients. It received the high basins of water exchange between two or three times the nutrients in the farm (N and P), while it needs nine times as much water and contains 10-14 times more nutrients than the low water-exchange ponds. Water and nutrient flows between ponds and other components of integrated farming and aquaculture should be considered in improving the productivity and profitability of integrated aquaculture and farming systems. **(De Silva et al., 2010)** estimated N and P discharges of striped catfish production fed with commercial feed at 46.0 and 14.4 kg per ton of fish, respectively.

(Masser et al., 1992) Using drainage water of fish farms to irrigate crops is considered an important step to overcome the problem of irrigation water shortage, Plants grow rapidly with dissolved nutrients that are excreted directly by fish or generated from the microbial breakdown of fish wastes. **(Wood et al., 2001)** reported that using fish pond effluent to irrigate wheat can improve grain yield comparing with conventional irrigation water and fertilization strategies in the Asia Pacific Region. **(Elnwishy et al., 2006)** Concluded that reusing drainage water of fish ponds reduces the total costs since it decreases the fertilizers using and improves soil quality and crops productivity, where it has high proportion of main nutrients needed by plants. **(Sikawa and Yakupitiyage, 2010)** investigate the effect of catfish pond water filtration (unfiltered vs partially filtered pond water) under hydroponic system on lettuce (*Lactuca sativa L.*) production and nutrient uptake. The results showed that partially filtered pond water treatments had significantly higher lettuce yield and adequate tissue N content. They concluded that filtration of catfish pond water enhanced the potential to use it for the hydroponic lettuce production. **(Eid et al., 2013)** resulted that, under sprinkler irrigation system using wastewater of fish farms can save 100% of irrigation water and at least 40% from mineral fertilizers, they attributed increasing potato yield irrigated with wastewater of fish farms to increase available dissolved elements and bio-components in it. **(Abdelraouf et al., 2014)** studied effect of water quality (traditional irrigation water and drainage water of fish ponds) and fertigation rate (25%, 50%, 75% and 100%) from recommended dose from NPK on soybean yield and water use efficiency under sprinkler irrigation system in sandy soil. The results indicated that, the maximum soybean yield and water use efficiency values were obtained with drainage water of fish ponds and 100% NPK. They added that at drainage water of fish ponds there is no significant difference between 100% NPK and 75% NPK, thus, using drainage water of fish ponds for irrigation as a new source under sprinkler irrigation system will save traditional irrigation water and about 25% from minerals fertilizers. **(Okasha et al., 2016)** Studied effect of two types of irrigation water (drainage water of fish ponds and traditional irrigation water) and four rates of N recommended dose (40%, 60%, 80%, and 100%) on soybean yield and water productivity under sprinkler irrigation system. The results referred that the highest values of seed yield and water productivity were obtained with drainage water of fish ponds at 100 and 80% N recommended doses respectively. They concluded that using drainage water of fish ponds saved 100% of irrigation water and 20%

from mineral fertilizers under sprinkler irrigation system. **(Urbano et al., 2017)** compared effect of treated wastewater with partial conventional fertilization and drinking water with conventional fertilization on lettuce quality under drip irrigation in greenhouse, the results showed that Lettuce production (fresh weight) was higher in lettuce cultivated at treated wastewater with partial conventional fertilization than that cultivated at drinking water with conventional fertilization. They concluded that, The treated wastewater quality was appropriate for lettuce under drip irrigation.

(Wu et al., 2008) reported that, the emitter was defined as ‘unclogged’ when clogging ratio was lower than 5 % , while 5–20 % was ‘slightly clogged, 20–50 % was ‘generally clogged’, and 50–80 % was defined as ‘seriously clogged’, and less than 20 % was ‘completely clogged’. **(Liu and Huang, 2009)** studied the effect of fresh water and treated sewage on clogging ratio and emitter discharge reduction and variation for three types of emitters, the results showed that using treated sewage increased clogging ratio and emitter discharge reduction and variation. **(Ismail et al., 2013)** determined the effect of treated wastewater on emitter clogging with four different types of emitters, one in line at 4 l h^{-1} discharge and the others on line at 4 l h^{-1}, 6 l h^{-1} and 8 l h^{-1} discharge. The results showed that, the degree of clogging increased almost linearly with operation time. In line emitter recorded highest clogging ratio. With on line emitters, clogging ratio were decreased by increasing discharge. They added that, the water source containing a high level of bacteria can lead to more sever clogging since it can accelerate slime buildup. **(Eid and Hoballah, 2014)** Studied effect of drainage water of fish farms (DWFF) on emitters clogging under sprinkler and drip irrigation systems. The results indicated that, clogging ratio was increased under DWFF more than under irrigation water, clogging ratio was higher under drip irrigation system comparing with sprinkler irrigation system this may be due to the increase in orifices diameter of sprinklers than drippers. **(Zhou et al., 2015)** studied effect of drip irrigation frequency on emitter clogging and biofilms growth using treated wastewater. They concluded that, the degree of emitter clogging and the biofilms components inside emitters increased with higher irrigation frequency.

The present study was carried out to study the utilization of fish effluent for irrigate leaf vegetable crops as a new resource of irrigation water and integrate system between fish (Nile Tilapia) and leaf vegetable crop (head lettuce) culture; therefore minimizing the amount of mineral fertilizers applied and evaluating the effect of effluent fish on emitters under drip irrigation system.

2. MATERIALS AND METHODS

2.1. Experimental layout:

Two field experiments were conducted during winter seasons of 2016 and 2017 from January to May at Horticulture research farm, Faculty of Agriculture, Kafrelsheikh University, north of the Nile Delta, Egypt, having a clay textured soil. The experimental field was prepared using the traditional preparing method and furrowed at 70 cm, the furrows were mulched with black plastic sheet (80 μm thickness) for warming the soil and preventing weed growth. Head lettuce "Limor HYB" variety was transplanted manually in February. Some Properties of irrigation water of the experimental field were conducted in Food technology Departments, Faculty of Agriculture, Kafrelsheikh University and presented in Table 1.

Table 1: Some Properties of irrigation water of open channel and fish ponds for experimental site.

	Parameter	Open channel water (traditional)	Effluent fish (fish pond)
1	Potential of Hydrogen, (PH)	7.38	7.41
2	Electrical conductivity, (EC, $mg.l^{-1}$)	717	800
3	Total dissolved solids, (TDS, $mg.l^{-1}$)	198	417
4	Ammonia, (NH_3, $mg.l^{-1}$)	0.012	0.181
5	Nitrite, (NO_2, $mg.l^{-1}$)	0.022	0.211
6	Nitrate, (NO_3, $mg.l^{-1}$)	0.68	1.67
7	Biological Oxygen demand, (BOD, $mg.l^{-1}$)	2.5	6.7
8	Total suspended solids, (TSS, $mg.l^{-1}$)	99	156
9	Dissolved oxygen, (DO, $mg.l^{-1}$)	3	4.5

$mg.l^{-1}$: milligram per litter

2.2. Drip Irrigation network:

Irrigation system under study consisted of centrifugal pump (62 l/min maximum discharge), 1 inch inlet and outlet diameters and 47 m maximum head driven by 0.75 kW electrical engine, fertigation unit, 120 mesh polyester screen filter, pressure gauge, control valves, main line, lateral lines and drippers. The main line made from solid PE pipes with 32 mm outer diameter (OD) to convey the water from the source to the lateral lines in the field. Lateral lines made of PE with 16 mm inner diameter (ID) and 25 m long and 30 cm spacing between drippers.

2.3. Fish ponds:

Two type of fish ponds were used in this experiment, the first type of fish pond was rectangular had the internal dimensions of 4 ×2 ×1.5 m. The second type was circular 2m diameter .Height of the water in that fish pond was 1 m. Fish pond wall was built from brick and had thickness of 26 cm. The inner layer of fish pond was painted with weather-coat to prevent splashing. Fish pond ground regular concrete thickness 25 cm and land drainage pipe hand tend. Pipe drainage had 1 m height. It was shaped letter L. The water level remains constant within the fish pond when required .The ground slope direction of fish pond was to drainage pipe. The fish pond was loaded with Nile tilapia (100 fish m^{-3}) had initial weight 50 g per fish. The fish were fed a commercial feed (crude protein, 28 %; crude lipid 4.96 %; crude fiber 5.08 %; total energy 4000 kcal/kg) long the experiments. The diet was offered twice a day, the daily feeding rate was of 6 % body weigh per day. About 15 % of the water was replaced daily by new fresh water.

The fish pond was provided with the air compressor capacity of 100 watts at a rate of 110 l of air per min for aeration the fish pond. The air compressor had been working for 15 min. and separated by 15 min. throughout the day. Dissolved Oxygen was measured with Dissolved Oxygen Meter (Range 0.0~20.0 mg. l^{-1}). Ammonia was measured with Mi405 Ammonia MR (range 0.00- 9.99 mg. l^{-1} (NH_3-N) accuracy ±0.10 mg. l^{-1}).

2.4. Fertigation:

Pressure differential tank was used for adding N mineral fertilizer. Ammonium Sulphate (20.6% N) was used to apply 80 Kg N/fed. for commercial lettuce production according to **(Abd El-Aal and El-Sharkawy, 2011)**, it was applied in three equal doses at third, fifth and seventh week from transplanting.

2.5. Study variables:

a. Irrigation water: two different sources of irrigation water; traditional irrigation water (IW) from open channel and drainage water of fish ponds (FW). Every day 15 % of fish ponds water were changed and collected in a separate collection pond.

b. Nitrogen Level: At drainage water of fish ponds three levels of N fertilizer was applied; 100% N, 75% N and 50% N, while at traditional irrigation water (IW), 100% N only was applied.

c. Emitter type: three emitter types were used as shown in Table 2.

Table 2: Classification of dripper types under study.

Symbol	Name	Builting	Flow	Discharge at 7m operating pressure head, l/h	
D_1	GR	In-line	Long path flow	4	
D_2	Targa Dripper	On-line	Turbulent flow	6	
D_3	E2	On-line	Laminar flow	4	

The experimental field layout and study treatments distribution are shown in Fig.1.

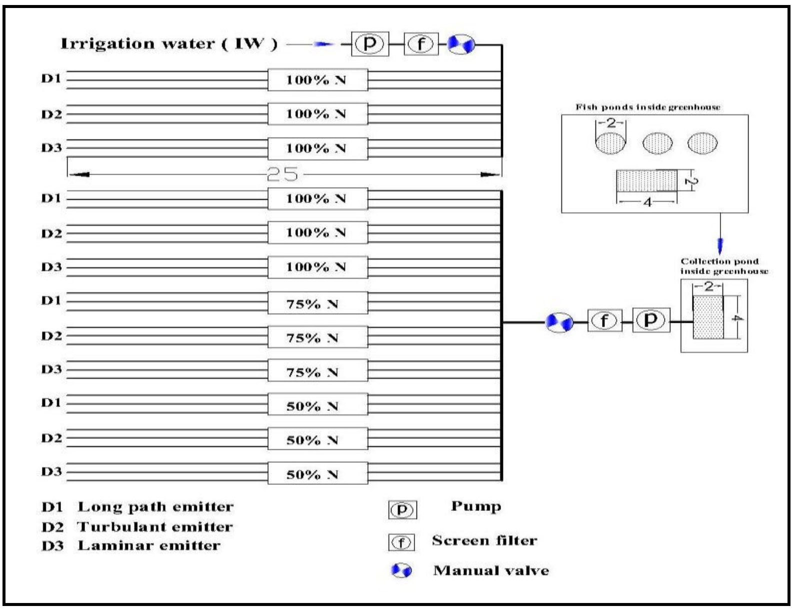

Fig.1: The experimental field layout and study treatments distribution.

2.4. Irrigation requirement:

CROPWAT 8 computer program that was depending on Penman-Monteith equation was used to calculate potential - evapotranspiration for lettuce crop according to climate station at Rice Research &Training Center, Sakha, Kafr El-Sheikh as shown in Figs. 2 and 3. The seasonal irrigation water applied including planting irrigation was found to be 414 m^3/fed, where 8.2 mm effective rain taking into consideration

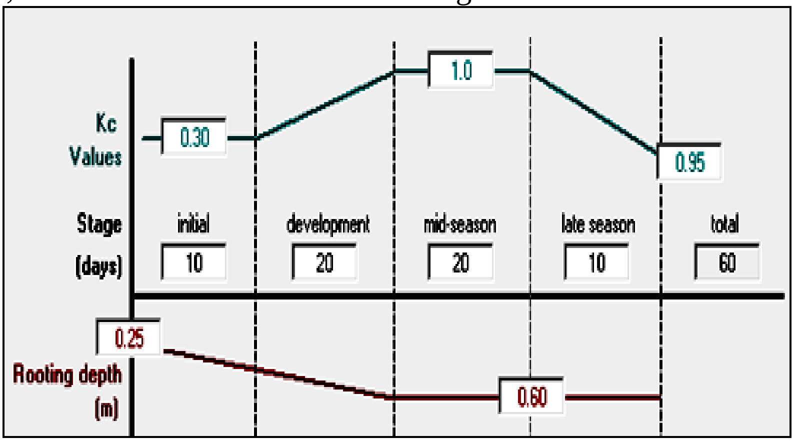

Fig. 2. Lettuce crop coefficient (kc) values at a growing stages.

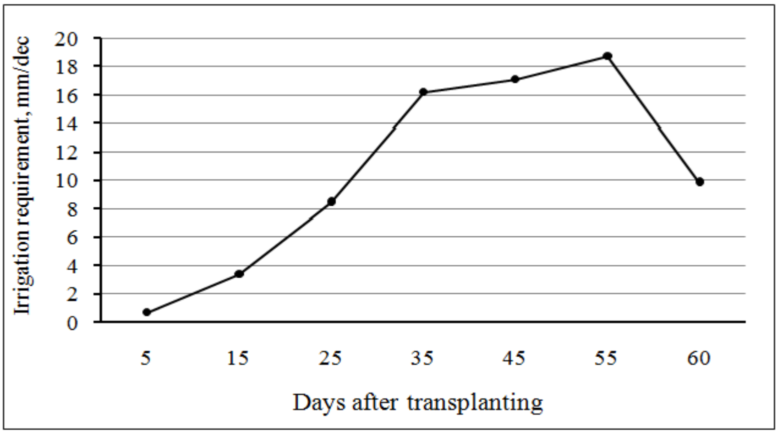

Fig. 3. An average of lettuce water requirement (mm) calculations during two growing seasons.

2.5. Measurements:

2.5.1. Evaluation of emitter clogging:

The relative emitter discharge expressed as a percentage was calculated according to **(Feng et al., 2017)** for every treatment and Clogging ratio was calculated as follow:

$$q_r = 100 \times (q / q_{ini}) \quad \ldots\ldots\ldots\ldots\ldots\ldots..(1)$$

$$CR = 1 - q_r \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where:

q_r = relative emitter discharge (%),

q = mean emitter discharge at end of growing season ($l.h^{-1}$),

q_{ini} = initial mean emitter discharge ($l.h^{-1}$) and

CR = clogging ratio of emitters (%).

2.5.2. Water application uniformity

Effect of source of irrigation water and emitter type on application uniformity at the beginning and end of every growing season was expressed by Christiansen uniformity coefficient (C_u) according to **(James, 1988)**.

$$C_u = 100 \left(1.0 - \frac{\sum |x_i - \bar{x}|}{n\bar{x}}\right) \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:

x_i = volume caught at observation point i,

$\bar{x}$ = average volume amount caught, and

n = number of observations.

2.5.3. Lettuce yield and its components:

At harvesting time, total plant yield, ton/fed and some yield components such as average marketable head yield, ton/fed; average external leaves weight/plant, g; average head height, cm and average head diameter, cm were measured, calculated and recorded for all given treatments under study.

2.5.4. Water productivity

Water productivity (WP), kg/ m^3 was calculated as following:

$$WP = \frac{\text{Total plant yield}, \left({kg}/{fed}\right)}{\text{Total applied irrigation water}, \left({m^3}/{fed}\right)} \ldots\ldots\ldots\ldots\ldots (4)$$

2.5.5. Nitrogen productivity

Nitrogen productivity (NP), $kg_{\ yield}/ kg_{\ N}$ was calculated as following:

$$NP = \frac{\text{Total plant yield}, \left({kg_{yield}}/{fed} \right)}{\text{Total applied nitrogen}, \left({kg\ N}/{fed} \right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

2.5.6. Fish growth parameters:

The growth rates were measured in terms of specific growth rate (SGR), weight gain during feed period (WGDFP) and feed conversation efficiency (FCE) as the following **(Carlos et al., 2015)**:

$$WGDFP = FW - IW \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where:

FW= final weight, g. IW= initial weight, g.

$$DGR = \frac{Fw - IW}{experimental\ period \times IW} \times 100 \quad \ldots\ldots\ldots\ldots (7)$$

Where:

DGR= daily growth rate, %

$$SGR = \left(\frac{\ln FW - \ln IW}{time\ (day)} \right) * 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

$$FCE = \frac{mass\ gained\ (g)}{total\ amount\ of\ feed\ consumed\ (g)} \quad \ldots\ldots\ldots\ldots (9)$$

2.5.6. Statistical analysis

Experimental design was split plot design “Water source and nitrogen level in main plot and Emitter type in sub plot”, statistical analysis was carried out by CoStat program for windows.

3. RESULTS AND DISCUSSION

3.1. Clogging Ratio

The average of clogging ratio (%) in relation to irrigation water, nitrogen level and emitter type for two growing seasons are shown in Fig 4. FW trended to increase clogging ratio comparing with IW for different emitter types, where clogging ratio increased by about of 64.71, 34.04 and 128.7% for D1, D2 and D3 emitters respectively under FW comparing with IW. Increasing nitrogen level from 50% to 75% tended to increase clogging ratio by about of 22.92, 10.14 and 13.81% for D1, D2 and D3 emitters respectively. While increasing nitrogen level from 75% to 100% increased clogging ratio by about of 10.17, 6.36 and 7.69% for D1, D2 and D3 emitters respectively. The highest value of clogging ratio was 31.5% which obtained at FW, 100%N and D3 emitter treatment, while the lowest value of clogging ratio was 5.7% which obtained at IW and D2 emitter. Through field viewing, it was observed that screen filter need to clean under FW every irrigation where suspended materials covered the screen completely, while under IW screen stay clean for two weeks. It is very important to choose the appropriate filtration system to minimize clogging ratio. Irrigation water, nitrogen level and emitter type had highly significant effect on clogging ratio.

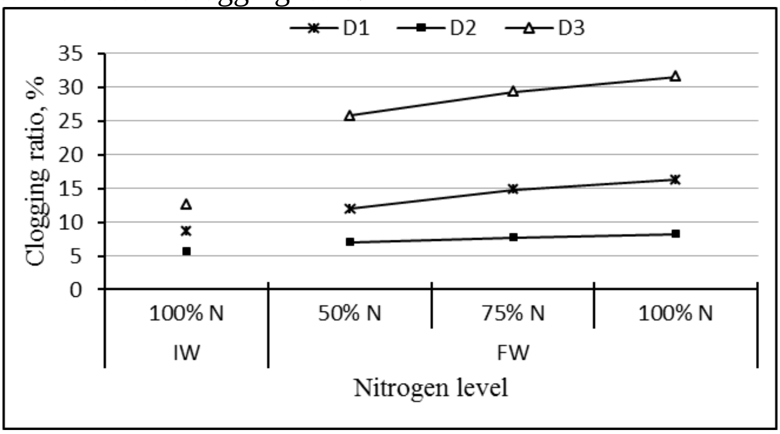

Fig. 4: The mean values of clogging ratio as affected by irrigation water source, nitrogen level and emitter type.

Classification of emitter clogging ratio for different treatments according to **(Wu et al., 2008)** are shown in Table 3. All emitter types had slightly clogged under different treatments except D3 under FW treatments had generally clogged.

Table 3: Classification of emitter clogging ratio for different treatments.

Emitter type	IW	FW		
	100% N	50% N	75% N	100% N
D1	(SL.)	(SL.)	(SL.)	(SL.)
D2	(SL.)	(SL.)	(SL.)	(SL.)
D3	(SL.)	(G)	(G)	(G)

SL: Slightly clogged G: Generally clogged

3.2. Water application uniformity

Application uniformity was expressed by Christiansen uniformity coefficient "C_u". An average of C_u at the beginning and end of growing seasons in relation to irrigation water, nitrogen level and emitter type for two growing seasons are shown in Fig 5. The obtained results indicated that, application uniformity at end of the growing season decreased comparing with it at beginning for all treatments. under FW, increasing nitrogen level decreased C_u for different emitter types; increasing nitrogen level from 50% N to 75% N decreased C_u by about of 3.6, 2.6 and 3.2% for D1, D2 and D3 emitters respectively and increasing nitrogen level from 75% N to 100% N decreased C_u by about of 6.2, 3.7 and 5.6% for D1, D2 and D3 emitters respectively. At 100% N, FW decreased C_u at end of the growing season more than IW by about of 12.5, 9.7 and 18.5% for D1, D2 and D3 emitters respectively. At end of the growing season, the highest C_u value was 95.1% which obtained by IW and D1 treatment, while the lowest C_u value was 70.3% which obtained by FW, D3 and 100% N treatment. Decreasing C_u value for D3 at end of the growing season comparing with D2 may be due to increasing clogging ratio for D3 more than D2. Irrigation water, nitrogen level and emitter type had highly significant effect on Christiansen uniformity coefficient.

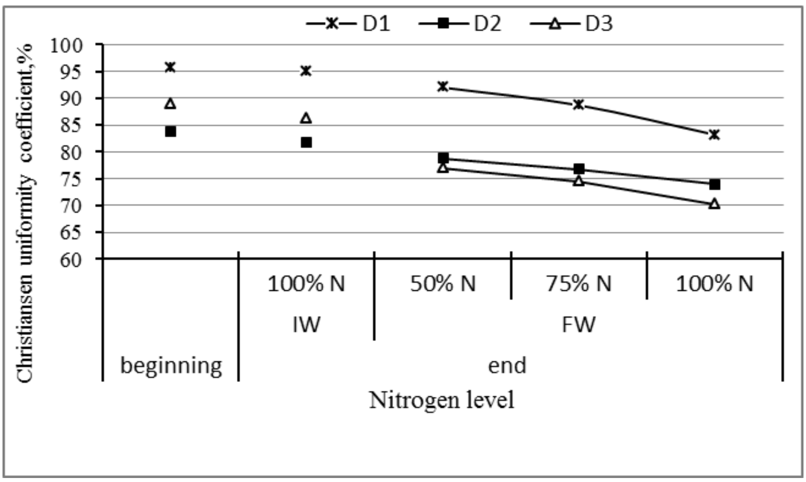

Fig. 5: The mean values of Christiansen uniformity coefficient as affected by irrigation water source, nitrogen level and emitter type.

3.3. Total head yield and yield components:-

a. Total head yield

The average of total head yield (ton/fed.) in relation to irrigation water, nitrogen level and emitter type for two growing seasons are shown in Fig 6. FW enhanced lettuce yield comparing with IW for different treatments. Under FW, increasing nitrogen level increased total head yield for different emitter types. Under FW increasing nitrogen level from 50% N to 75% N increased total head yield by about of 30.9, 3.7 and 16.2% for D1, D2 and D3 respectively, increasing nitrogen level from 75% N to 100% N increased total head yield by about of 13.2, 6.7 and 9.1% for D1, D2 and D3 respectively. Decreasing total head yield for D3 comparing with D1 and D2 may be due to increasing clogging ratio and/or decreasing application uniformity. Under 100% N level FW increased total head yield comparing with IW by about of 51.2, 50.2 and 61.3% for D1, D2 and D3 respectively. Increasing total head yield under FW may be due to the amount of additional nitrogen that has been added by fish water where this is appropriate with the nature of leaf crop. The highest total head yield was 15.7 ton/fed. which obtained by FW, 100% N and D2 emitter type treatment, while the lowest total head yield was 7.37 ton/fed. which obtained by IW and D3 emitter type treatment. Irrigation water; nitrogen level and emitter type had highly significant effect on total head yield.

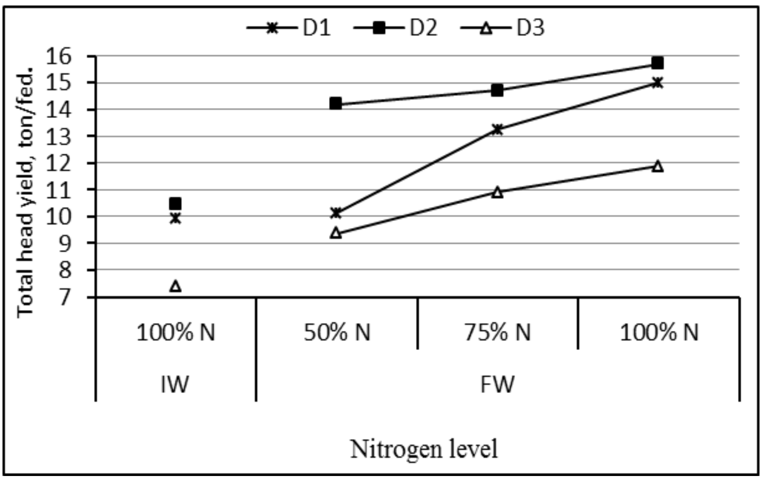

Fig. 6: The mean values of total head yield as affected by irrigation water source, nitrogen level and emitter type.

b. yield components

Effect of irrigation water, nitrogen level and emitter type on marketable head weight without external leaves, g/plant; head height, cm and head diameter, cm are listed in Table (5). The obtained results indicated that, yield components have the same trend as total head yield, FW increased yield components comparing with IW for all treatments. Under FW increasing nitrogen level increased yield components. The highest yield component values were 0.8 g/plant, 13.8 cm and 14.7 cm for marketable head weight, head diameter and head height respectively which obtained by FW, 100% N and D2 emitter type treatment, while the lowest yield component values were 0.3 g/plant, 9.7 cm and 10.3 cm for marketable head weight, head diameter and head height respectively which obtained by IW and D3 emitter type treatment.

Table 4: Effect of irrigation water, nitrogen level and emitter type on the yield components.

Yield components	Emitter type	IW	FW		
		100% N	50% N	75% N	100% N
marketable head weight, (g/plant)	D1	0.4	0.5	0.7	0.8
	D2	0.4	0.7	0.7	0.8
	D3	0.3	0.4	0.6	0.6
head diameter, (cm)	D1	10.9	12.1	12.6	13.5
	D2	11.3	12.4	13.7	13.8
	D3	9.7	10.9	12.0	12.5
head height, (cm)	D1	11	12.1	13.5	13.5
	D2	11.5	12.7	14.1	14.7
	D3	10.3	11.1	11.6	13.3

2.4. Water and nitrogen productivity

An average of water productivity in relation to irrigation water source, nitrogen level and emitter type for two growing seasons are shown in Fig

7. The results indicated that, water productivity have the same trend as total head yield, FW enhanced water productivity comparing with IW for different treatments. Under FW, increasing nitrogen level increased water productivity for different emitter types.. Under FW increasing nitrogen level from 50% N to 75% N increased water productivity by about of 31.2, 3.8 and 15.9% for D1, D2 and D3 respectively, increasing nitrogen level from 75% N to 100% N increased water productivity by about of 13.1, 6.5 and 9.1% for D1, D2 and D3 respectively. Decreasing water productivity for D3 comparing with D1 and D2 may be due to decreasing total head yield. Under 100% N level FW increased water productivity by about of 50.8, 50.4 and 61.2% for D1, D2 and D3 respectively comparing with IW. Increasing water productivity under FW may be due to increasing total head yield. The highest water productivity was 37.9 kg/m^3. which obtained by FW, 100% N and D2 emitter type treatment, while the lowest water productivity was 17.8 kg/m^3 which obtained by IW and D3 emitter type treatment. irrigation water; nitrogen level and emitter type had highly significant effect on water and nitrogen productivity.

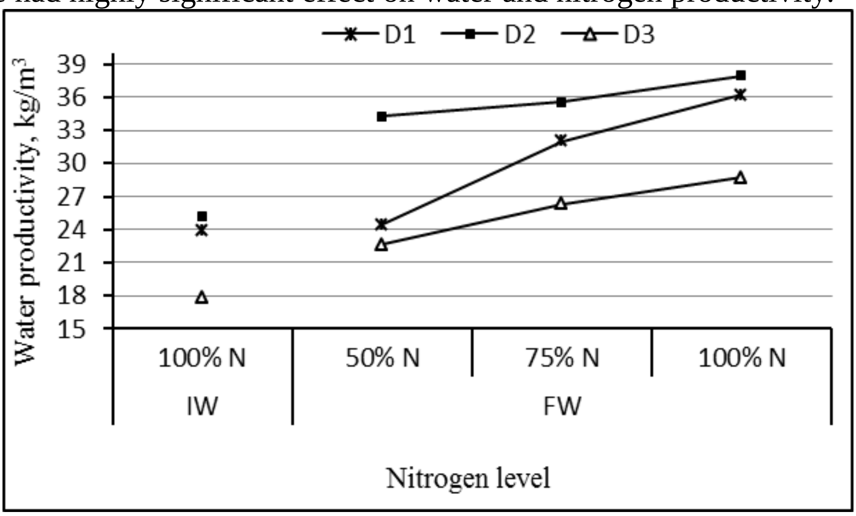

Fig. 7: The mean values of water productivity as affected by irrigation water source, nitrogen level and emitter type.

The results indicated that, nitrogen productivity have the same trend as water productivity where FW enhanced water productivity comparing with IW for different treatments as shown in Fig 8.

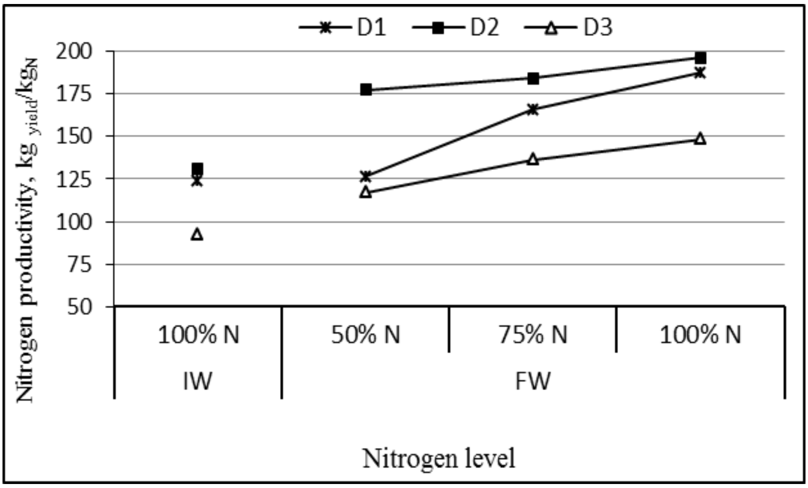

Fig. 8: The mean values of nitrogen productivity as affected by irrigation water source, nitrogen level and emitter type.

3.4. Fish growth rate:

The results remarkable that, no noticeable difference between fish growth parameters observed under this technique of water exchange with control treatment (common method for water exchange) (Table 6). Weight gain during feed period values were 52.95 and 52.42 g at the technique of water exchange and control treatment respectively. While, the Specific growth rate and Feed conversion efficiency hade the same values in all treatments.

Table 5: Comparing between fish growth parameters observed at the technique of water exchange and control treatment.

Parameters	Technique of water exchange	Traditional
Initial weight(IW), g	50.5	50.5
Final weight (FW), g	103.45	102.92
Weight gain during feeding period (WGDFP), g	52.95	52.42
Daily growth rate (DGR), %	1.73	1.73
Specific growth rate (SGR), %	1.2	1.18
Feed conversion efficiency (FCE), %	82.93	81.8

CONCLUSION

Reusing drainage water of fish ponds can enhance lettuce yield where it rich with soluble nitrogen and increase water and nitrogen productivity thus reduce mineral fertilizer doses. To be drainage water of fish ponds more suitable to use under drip irrigation, choosing appropriate filtration system very important to minimize clogging ratio.

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الملخص العربي

الإدارة المتكاملة لمزارع الأسماك (البلطي النيلي) ومحاصيل الخضر الورقية (خس الرؤوس) تحت نظام الري بالتنقيط

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يعتبر ماء صرف المزارع السمكية مصدر آمن للري والتسميد في نفس الوقت . تم إجراء تجربة حقلية بالمزرعة البحثية لقسم البساتين - كلية الزراعة – جامعة كفر الشيخ خلال موسمي شتاء ٢٠١٥/٢٠١٦ و ٢٠١٦/٢٠١٧ بغرض دراسة تأثير نوعية ماء الري (الماء المنصرف من أحواض السمك و ماء الري العادي) على إنتاجية خس الرؤوس وكذا آداء النقاطات تحت نظام الري بالتنقيط وذلك تحت ثلاث أنواع من النقاطات (الأول: ذو سريان طويل المسار، مثبت داخل الخط الحقلي، تصرف ٤ل/س "D1"، الثاني: ذو سريان اضطرابي، مثبت على الخط الحقلي، تصرف ٦ل/س "D2"، الثالث: ذو سريان رقائقي، مثبت على الخط الحقلي، تصرف ٤ل/س "D3") وثلاثة نسب من جرعة النيتروجين المعدني الموصى به (١٠٠٪ ، ٧٥٪، ٥٠٪) مع الماء المنصرف من أحواض السمك ، بينما تم تطبيق نسب التسميد المعدني الموصى بها (١٠٠٪) مع ماء الري العادي.

أشارت أهم النتائج المتحصل عليها إلى زيادة نسبة انسداد النقاطات مع الماء المنصرف من أحواض السمك مقارنة بماء الري العادي وذلك نتيجة ارتفاع نسبة الرواسب به مقارنة بماء الري العادي، كانت اعلى نسبة انسداد مع النقاط ذو السريان الخطي بينما اقل نسبة انسداد كانت مع النقاط ذو السريان المضطرب. انخفضت انتظامية الإضافة في نهاية الموسم للماء المنصرف من أحواض السمك بنسبة اعلى منها مع ماء الري العادي ويرجع ذلك إلى نسبة الانسداد الأعلى. زادت الإنتاجية باستخدام الماء المنصرف من أحواض السمك بنسبة تتراوح ما بين ٥٠.٢% و ٦١.٣% لأنواع النقاطات المختلفة مقارنة باستخدام ماء الري العادي. أدى استخدام الماء المنصرف من أحواض السمك إلى زيادة إنتاجية الماء والنيتروجين مقارنة باستخدام ماء الري العادي . معدل الزيادة في الوزن خلال فترة التغذية للاسماك كانت ٥٢.٩٥ و ٥٢.٤٢ جرام لكل من التقنية المستخدمة في الزراعة المتكاملة والتربية العادية علي الترتيب.

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