EFFECT OF USING FISH BASINS DRAINAGE WATER, MULCHING AND WATERING REGIME ON CABAGE CROP PROPERTIES UNDER DRIP IRRIGATION SYSTEM

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ABSTRACT

Water scarcity in Egypt increased with rapidly population growth which represents a great challenge for the Government. The reuse of drainage water produced from various agricultural sources including cultivated lands and fish farming systems could a robust solution for horizontal expansion of cultivated area. This research aimed to assess the feasibility of using the drainage water of fish farming basins to irrigate cabbage crop. Three different watering regimes (100%, 80% and 60% ETc) and two types of water (canal water and fish farming drainage water) were investigated under two conditions (mulching with rice straw and without mulching). The results demonstrated that drainage water of fish increased the yield of all cabbage components. The combination of 100 % ETc, and drainage water of fish with mulching produced the highest head yield of 197.5 Mg ha^{-1} comparing with other treatments. Fish water increased yield by 1.7, 49.3 and 30.6% under 100, 80 and 60 ETc respectively. Marketable head yield, head diameter and head height had the same trend. The highest values of Marketable head yield, head diameter and head height were 167.9 Mg ha^{-1}, 70.4 cm and 59.5 cm, respectively. The results also showed that low watering regime (60 % ETc) resulted less head yield and other yield components regardless the influence of water type and using mulching.

Key words: *fish, water, regime, mulching, drip, irrigation and cabbage*

INTRODUCTION

The River Nile is the backbone of Egypt's industrial and agricultural sectors and is the primary source of drinking water for most of the population. Rapidly population growth and rapid economic development in Egypt, pollution and environmental degradation are

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decreasing water availability in the country and thus the optimum use of water resources is fundamentally crucial. In this context, exploring robust solutions to some aspects of Egypt's water-scarcity problem is necessary. This includes for example the use of water in agriculture more efficiently, desalinating brackish water, and to reuse low quality water produced from agricultural lands and fish farms.

Previous studies showed the importance of the reuse of drainage water of fish farming systems to face the challenge of water shortage. For instance, **Masser et al. (1992) and Abdelraouf et al. (2014)** revealed that the reuse of drainage water of fish farming systems is considered an alternative and a step forward to overcome the challenge of water scarcity. **Wood et al. (2001)** assessed the potential of fish ponds drainage water to irrigate wheat and pointed out that the fish ponds drainage water can enhance wheat yield and save in the mean time the amount of fertilizers required for wheat production. **Okasha et al. (2016)** quantified the effect of water type (canal water and drainage water of fish farming systems), and nitrogen rate on the yield of soybean under sprinkler irrigation system and concluded drainage water of fish farms produced higher soybean yield and water productivity comparing with canal fresh water. **Sikawas and Yakupitiyage (2010)** assessed the potential of using drainage water of fish ponds to grow lettuce and found that filtering fish ponds drainage water has the effective use for the hydroponic lettuce production. **Attafy and Elsbaay (2017)** used fish effluents to drip irrigate lettuce crop under various nitrogen fertilization levels and found that fish drainage water led to higher lettuce yield, nitrogen productivity comparing with canal fresh water.

The protocol of feeding air-breathing fish ends up with accumulation of fecal, feed and excretory effluents in fish basins water (**Yi et al., 2003 and Porrello et al., 2005**) these effluents rich in nutrients and elements that are fundamentally important for crop growth can provide a robust source for fertilizing agricultural crops. **Lin and Yi (2003)** concluded that the use of catfish waste water to irrigate crops has been demonstrated among the most cost-effective effluent treatment option.

The overall aim of this research study was to assess the potential of reusing drainage water of fish farming systems as an alternative successful source of water and nitrogen to irrigate cabbage. The objectives of this research study were to i) study the impact of the reuse of drainage water of fish farming basins on cabbage yield, ii) increase nitrogen productivity of cabbage crop and iii) increase cabbage head total yield and thus water productivity.

MATERIALS AND METHODS

Study area and soil analyses

A field experiment was conducted in summer growing season of 2018 to assess the potential of reusing the drainage water of fish basins to irrigate cabbage crop. The experiment was executed at the Horticulture Research Station, Faculty of Agriculture, Kafrelsheikh University. The research aims to use an alternate source of fresh water which is rich in nitrogen and thus reduce the amount of fertilizers required for the crop. The experimental soil was classified as a clay soil with 1.27 g/cm^3 average soil bulk density. The volumetric water content values were measured using pressure membrane as 44.5, and 20.85 % at field capacity, and wilting points, respectively. The mechanical analysis of the experimental soil including sand, silt and clay percents is detailed in Table (1). Table (2) details the chemical analysis of the experimental soil including anions, cations, EC, pH at various soil depths. Cabbage was transplanted in the first week of May and the growing season lasted to 115 days after transplanting. Nitrogen fertilization in the form of ammonium nitrate was added at the recommended rate (285 kg N ha^{-1}) in three equal doses at 30 45 and 60 days after transplanting. A pressure differential tank was used for the application of nitrogen fertilizer.

Table (1): Mechanical analysis and some soil physical properties

Depth, cm	ρ_b, g/cm^{-3}	FC, %	WP, %	AW, %	Particle size distribution,			Texture
					Sand	Silt	clay	
0-15	1.21	44.5	20.85	23.65	22.52	20.05	57.43	Clay
15-30	1.27	40.63	21.15	19.48	21.89	24.82	53.29	Clay
30-45	1.34	38.39	22.44	15.95	18.95	24.03	57.02	Clay

FC, field capacity; WP, wilting point; AW, available water; **ρ_b**, bulk density

Table (2): Chemical analysis of the experimental soil including anions, cations, EC, and pH at different soil depths

Soil depth,	EC, dS/m^{-1}	pH	Cations, meq/L				Anions, meq/L			
			Mg^{++}	Ca^{++}	K^{+}	Na^{+}	Co_3^{--}	HCo_3^{-}	Cl^{-}	So_4^{--}
0-15	2.99	8.13	11.64	7.91	0.31	12.31	0.01	6.9	13.2	12.06
15-30	2.95	8.17	8.91	7.32	0.28	13.05	0.03	9. 7	9.6	10.23
30-45	2.98	8.21	9.12	6.01	0.34	14.3	0.03	10.8	9.2	9.74

Irrigation system and experimental layout

A drip irrigation network (Fig. 1) was constructed to irrigate the experimental plots. The drip irrigation network consisted of a 2 hp electrical engine that operates a 62 L/min centrifugal pump to deliver water from irrigation channel or from the fish drainage water collecting basin. The network also included a fertigation unit, 120 mesh polyester screen filter, main and lateral lines, control valves and pressure gages. A 2 inch main line diameter made of PE was connected to the pumping unit to convey water to 16 mm PE lateral lines. Lateral lines were 25 m in length with 30 cm dripper spacing.

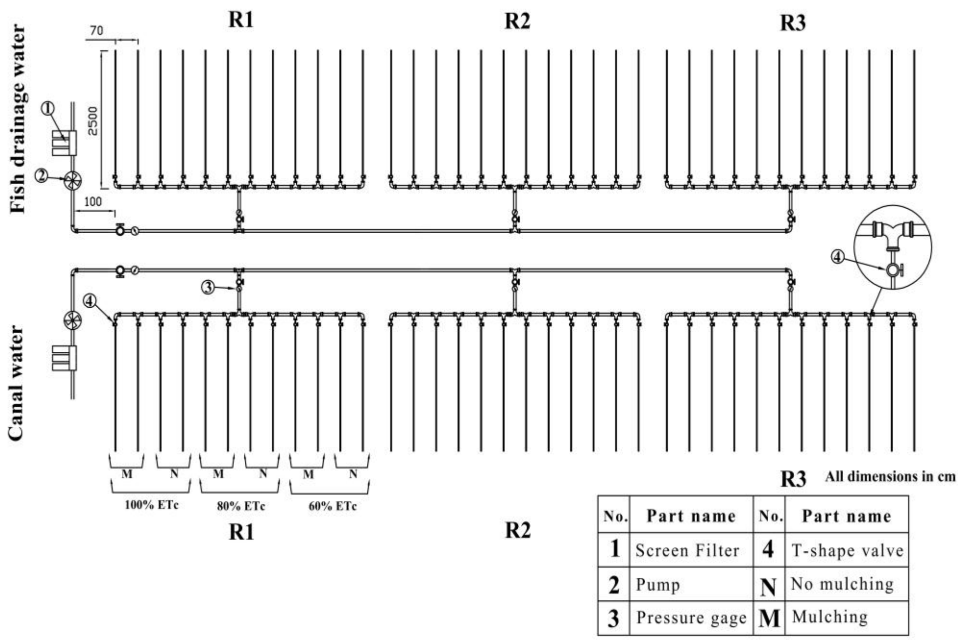

Fig. (1): Layout of drip irrigation system and the distribution of various treatments of the present study

T-shape valves were installed at the start of each lateral line to control the amount of water delivered to each lateral line. Built in-line drippers of 4 l/h were used for this network. To avoid delivering solid wastes and larger sediments to drip irrigation network, the beginning of water suction pipe was put in a cage covered by a double layers of net with very tiny holes having 0.5 mm diameter. The experiment soil was furrowed at 0.7 m spacing which was the same distance between lateral lines and the drippers were 0.3 apart.

Irrigation Water Requirements

Crop water requirements as illustrated in Fig (2) were calculated using CROPWAT v8 package based on Penman-Monteith formula. The potential evapotranspiration for cabbage was calculated taking into consideration the climatological data of the study site that collected by the Climate Station at Rice Research and Training Centre, Sakha, Kafr-Elsheikh and Table (3) details the agro-climatological data. The total amount of seasonal irrigation water applied including the amount applied for planting was counted at 5378.8 m^3 ha^{-1}.

Table (3): Agro-climatological data for the study area recorded at Sakha Research Station (latitude of 31.11^o and longitude of 30.95^o)

Month	T_{max}, ^oC	T_{min}, ^oC	U_2 (km/day)	RH (%)	SH (h)	SR Mj/mday	ET_O (mm/day)
April	29.3	12.1	89.7	63.53	12.5	30.8	4.40
May	29.6	16.7	99.3	56.05	13.0	31.5	5.62
June	33.5	18.3	107.5	61.35	13.9	31.9	6.49
July	33.0	19.7	102.0	65.10	13.7	32.7	6.24
August	36.1	20.2	105.0	67.20	14.9	35.4	5.50
September	31.6	20.2	98.0	60.47	13.6	33.7	4.60
October	30.1	19.3	109.0	58.62	6.4	31.9	3.60

RH, relative humidity; U_2, wind speed; SH, sunshine hours; SR, solar radiation

Fish farming system

Two different fish basins designs were installed for this research study. Rectangular and circular fish basins were constructed for the fish farming system. The net dimensions of rectangular basins were 4*2*1.5 m (length * width * height) while the circular shape was 2 m diameter.

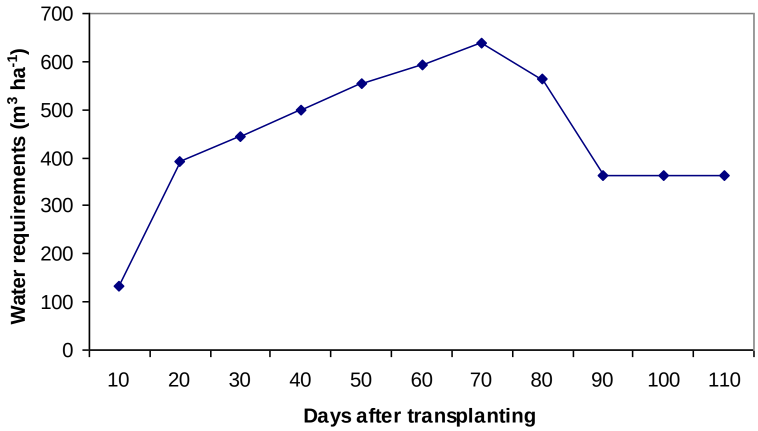

Fig. (2): Average monthly water applied to drip irrigated cabbage in 2018 summer season

Walls of both basins were constructed from bricks of 25 cm thickness and 25 cm of concrete was used for the bottom of basins to prevent water from percolation to the soil**.** Water in different basins was kept at 1m height. A pipe of 2 inch diameter was installed at the bottom of each fish basin to drain water to the collecting basin. Every two days a third of each fish basin's water was replaced by fresh canal water. A 50 m^2 basin was constructed to collect the drainage water from fish basins. Care was taken during pumping water from the collecting basin to avoid pumping solid wastes from nearby the base. The suction pipe was kept at the half of the water depth to be away from the sediments resulted from fish basins. A 2 inch pipe connected between the collecting basin and the drip irrigation network. Water level was remained at a constant height throughout the experiment. Samples of drainage water of fish basins were collected for analyzing and Table (4) lists the chemical analysis of these samples. 20 g per fish initial weight Nile tilapia was loaded for all basins at a density of 100 fish per cubic meter of water. The ingredients of fish feed were 4.96 % crude lipid, 28% crude protein and 5.08 % crude fibber which produces a total energy of 4000 kcal kg^{-1}. For the aeration purpose, fish basins were equipped with a 100 watts compressor which provides 110 L min^{-1} of air. The compressor was automatically adjusted to work 15 min per each hour. Ammonia was measured by an ammonia meter (Mi405 with a range of 0-9.99 mg.L^{-1}) and dissolved oxygen was measured by an oxygen meter (range of 0-20 mg.L^{-1}). Chemical analysis of fish basins drainage water was performed and different properties are detailed in Table (4).

Table (4): Chemical analysis of canal and fish basins drainage water

		Element							
		EC, dS/m	**pH**	**NO_3, mg/L**	**NO_2, mg/L**	**NH_3, mg/L**	**TDS, mg/L**	**TSS, Mg/L**	**DO, mg/L**
water Source	CW	1.06	7.14	0.77	0.034	0.017	181	107	2.8
	DW	1.15	7.65	187	0.24	0.23	392	173	3.76

CW, canal water ; DW, drainage water of fish basins; DO, dissolved Oxygen; TSS, total suspended solids; NO3, nitrate; NO2, nitrite; NH3, ammonia.

Water productivity (WP)

Water productivity (kg m^{-3}) was determined as the ratio between cabbage head yield and the amount of applied water and was quantified according to **Rodrigues and Pereira (2009)** as follows:

$$WP = Y/ W,$$

Where: WP is water productivity in kg m^{-3}, Y is the cabbage total head yield in Mg ha^{-1} and W is the amount of water applied in m^3 ha^{-1}

Nitrogen productivity (NP)

Nitrogen productivity was determined as the ratio between the total cabbage yield in kg per hectare and the total amount of nitrogen fertilization applied for each treatment.

Statistical Analysis:

SAS software package (**SAS Institute, 2003**) was run to subject experimental data to statistical analysis. Least significant difference (LSD) at 5% significance level was used to compare the means of various treatments. SAS also was used to quantify the coefficient of correlation.

RESULTS AND DISCUSSION

a. Cabbage head and marketable yield

Total cabbage head yield was significantly affected by the three investigated parameters including water regime, water type and mulching as detailed in Table (5). It is also shown that the interaction between water type, water regime and mulching was significant in all combinations of various parameters. Broadly, it is clear that the reuse of fish drainage water enhanced the total head and marketable yield of cabbage regardless the effect of the other two investigated parameters. At all irrigation regimes, reusing fish drainage water produced the highest head and marketable yield of cabbage. The highest values of cabbage head and marketable yield were 197.5 and 167.9 Mg ha^{-1} under the treatments of using fish drainage water, 100 % ETc with mulching while the minimum values were 61.88 and 37.6 Mg ha^{-1} respectively with the combination of canal water, 60% ETc without mulching. The results in Table (6) also revealed that applying less water caused a decrease in head and marketable yield. Fish water increased yield by 1.7, 49.3 and 30.6% under 100, 80 and 60 ETc respectively. The combinations included 60 % ETc gave less head and marketable yield among all treatments. From the above mentioned results the increase in head and marketable yield of cabbage may have been a result of additional nitrogen source that comes from fish effluents which is rich in nitrogen and other nutritional elements. These elements are essential for plant growth and motivate plants to perform various processes.

Table (5): Analysis of variance for the experimental variables on cabbage head yield

Source	D.F	Sum of squares	Mean square	F value
Replicates	2	10.079	5.04	3.39
Water type (A)	1	5019.9	5019.9	3381.8**
Error	2	2.97	1.48	
Water regime	2	46391.7	23195.9	2419.4**
A*B	2	157.9	78.95	8.24*
Error	8	76.69	9.59	
Mulching (C)	1	8289.8	8289.8	643.79**
A*C	1	129.2	129.2	10.03**
B*C	2	3845.1	1922.5	149.3**
A*B*C	2	113.1	56.5	4.39*
Error	12	154.52	12.88	

Table (6): Effect of water type, watering regime and mulching on cabbage head yield (Mg ha^{-1}) and marketable head yield (Mg ha^{-1})

Water type	Irrigation regime	Head yield		Marketable head yield	
		Mulching			
		With	without	With	without
Canal water	100 % ETc	185.64	119	148.51	99.25
	80 % ETc	85.68	66.64	59.98	39.51
	60 % ETc	78.54	**61.88**	47.12	**37.60**
Fish drainage water	100 % ETc	**197.54**	145.18	**167.91**	101.15
	80 % ETc	109.48	101.15	82.11	77.89
	60 % ETc	102.34	83.30	71.64	54.15
Mean		126.5	96.19	92.21	68.26

b. Cabbage head diameter and height

The results in Table (7) detail the effect of water type, watering regime and mulching on head diameter of cabbage. It is obvious that the optimum watering regime (100 ETc) motivated the growth rate of cabbage and thus produced larger head diameter. Applying less watering regime by 20 and 40 % led to decrease cabbage head diameter by 31 and 41 % comparing with 100 % ETc in case of canal water with mulching and by 25 and 31 % when using fish drainage water with mulching. Data had the same trend in case of no mulching used since higher cabbage head diameter was recorded with 100 % ETc followed by 80% and 60 % ETc. For both types of water full irrigation regime produced the highest cabbage head diameters with respective values of 29.6 and 28.7 cm for fish drainage water and canal water. When considering the influence of mulching, it is demonstrated that in all treatments set mulching in both cases of water type gave higher head diameters in comparison to the case of non mulched combinations. Furthermore it is clear that using mulching by rice straw motivate the cabbage growth in terms of head diameter. This can be relied on reducing evaporation from the wetted bulbs and the therefore increase water availability throughout the root zone that improve nutrients uptake.

Head height had the same trend as the cabbage head diameter. The results showed that the highest cabbage head height was recorded with the treatment received 100 ETc, FW with mulching while the minimum values were obtained from the combination of CW plus 60 % ETc without mulching.

Table (7): Effect of water type, watering regime and mulching on cabbage head diameter and height (cm)

Water type	Irrigation regime	Head diameter		Head height	
		Mulching			
		With	Without	With	Without
Canal water	100 % ETc	28.7	20.2	22	20
	80 % ETc	19.7	18.8	19.5	17.5
	60 % ETc	16.9	**14.9**	17.5	**17**
Fish drainage water	100 % ETc	**29.6**	22.3	**25**	22
	80 % ETc	22.3	20.7	20	18
	60 % ETc	20.7	19.1	18	17
Mean		22.98	19.33	20.33	18.58

c. Cabbage water productivity

Water productivity (WP) was significantly impacted by irrigation water type, mulching and watering regime. Data detailed in Table (8) shows the statistical analysis of the effect of the three parameters used on cabbage total head yield showing that they significantly affected WP. It is seen in Table (9) that drainage water of fish basins produced higher WP in comparison to canal water since the highest WP of 36.7 kg m^{-3} was obtained with the treatment received fish drainage water, 100 % ETc with mulching. Fish water increased yield by 16.1, 27.6 and 24.6% under 100, 80 and 60 ETc respectively. The results demonstrated that covering the wetted area by rice straw enhanced cabbage growth rate by reducing evaporation from the soil surface and therefore more availability of water for plants. Applying less water (60% ETc) produced higher WP when comparing with 80 % ETc that produced less WP. The minimum records of WP were obtained with the combination canal water, 80 % ETc without mulching by rice straw. Although 100 ETc gave the highest records of cabbage yield, 60% ETc is more advantageous when taking into consideration water scarcity as a determinant factor.

Table (8): Analysis of variance for the experimental variables on cabbage water productivity

Source	D.F	Sum of squares	Mean square	F value
Replicates	2	0.507	0.254	1.419
Water type	1	300.09	300.09	1679.47**
Error	2	0.357	0.179	
Water regime	2	486.53	243.26	497.67**
A*B	2	22.66	11.33	23.18**
Error	8	3.91	0.489	
Mulching (C)	1	390.72	390.72	597.32**
A*C	1	4.93	4.93	7.53**
B*C	2	97.97	48.98	74.88**
A*B*C	2	5.32	2.66	4.07*
Error	12	7.85	0.654	

Table (9) Effect of water type, watering regime and mulching on water productivity of cabbage (kg m^{-3})

Water type	Irrigation regime	WP (kg m^{-3}) Mulching With	WP (kg m^{-3}) Mulching without	Mean
Canal water	100 % Etc	34.5	22.1	28.3
	80 % Etc	19.87	**15.5**	17.69
	60 % Etc	24.33	19.17	21.75
Fish drainage water	100 % Etc	**36.7**	26.9	31.8
	80 % Etc	25.38	23.5	24.44
	60 % Etc	31.83	25.83	28.83
Mean		23.5	17.9	

d. Nitrogen productivity

Data illustrated in Fig. (3) and depicted in Table (10) show the effect of water type, mulching with rice straw and watering regime on nitrogen productivity of cabbage crop. It is seen that the average values of nitrogen productivity were remarkably enhanced by irrigation with fish basins drainage water.

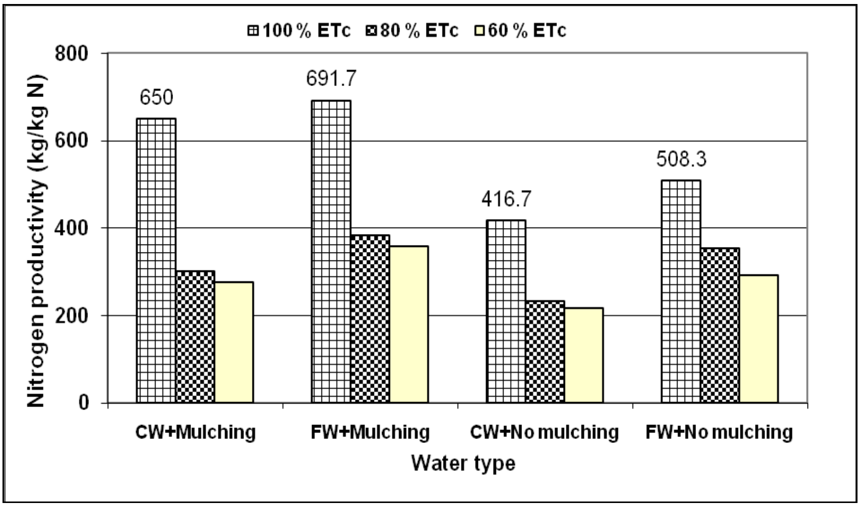

Fig (3): Effect of water type, watering regime and mulching on nitrogen productivity of cabbage

Table (10): Effect of water type, watering regime and mulching on nitrogen productivity of cabbage (kg/kg N)

Water type	Irrigation regime	Mulching		Mean
		With	without	
CW	100 % Etc	650	416.7	533.4
	80 % Etc	300	233.3	266.7
	60 % Etc	275	**216.7**	245.9
DW	100 % Etc	**691.7**	508.3	600
	80 % Etc	383.3	354.2	368.8
	60 % Etc	358.3	291.7	325
Mean		443.1	336.8	

DW, fish drainage water; CW, canal water

Mulching also encouraged nitrogen productivity since higher values were obtained with the combination included mulching with rice straw. The highest record of nitrogen productivity of 691.7 kg/kg nitrogen was obtained from the treatment received fish drainage water, 100 % ETc with mulching while the minimum value of 216.7 kg/kg nitrogen was recorded with the combination canal water, 60 % ETc without mulching. The obtained results demonstrated that fish basins drainage water would be a good source of water and nitrogen for the irrigation of leafy crops such as cabbage and lettuce. It is also obvious that applying less water to cabbage significantly decreased cabbage properties since the surface area for evapotranspiration is larger.

CONCLUSION

This research attempted to assess the possibility of reusing the drainage water of fish farming systems to irrigate cabbage crop. The study was based on the hypothesis that the drainage water of fish farming system could be a potential alternative safe source of irrigation water and nitrogen. The results of this research obviously indicated that the reuse of drainage water of fish farming systems can increase head yield, water productivity, nitrogen productivity and other components of cabbage yield. The results further showed that mulching not only motivate cabbage growth by increasing the availability of water in the root zone but also improve nutrients uptake and thus produce higher head and marketable yield. The novel idea presented her is the combination between watering regime, mulching by rice straw and using fish drainage water with drip irrigation system to have better irrigation and fertilization management. Moreover, the study showed the effectiveness of using fish drainage water as a source of nitrogen and other nutrients necessary for cabbage growth.

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الملخص العربي

تأثير استخدام مياه صرف احواض السمك والتغطية ومعدل اضافة المياه على خواص محصول الكرنب تحت نظام الرى بالتنقيط

عادل هلال المتولى* و مى محمد عامر**

ان الزيادة المطردة فى عدد السكان وتزامنها مع ثبات مصادر المياه المتاحة لمصر متمثلة بصفة اساسية فى مياه نهر النيل (٥٥,٥ مليار م٣) ، تعتبر التحدى الاساسى للحكومات المتاعقبة. وبالتالى لابد من استخدام المياه المتاحة باعلى كفاءة ممكنة وهذا يتمثل فى استخدام نظم الرى الحديث كالرى بالرش والرى بالتنقيط. كذلك لابد من ايجاد بدائل اخرى لرى المحاصيل ومن هذه المصادر نجد مياه الصرف الزراعى ومياه صرف المزارع السمكية التى تتميز بمحتواها العالى من النيتروجين وبالتالى تقليل كمية الاسمدة اللازمة. لذلك تهدف هذه الدراسة إلى دراسة امكانية استخدام مياه صرف المزارع السمكية لرى محصول الكرنب كبديل لمياه الرى العادية. أجريت هذه الدراسة فى مزرعة البساتين التابعة لكلية الزراعة – جامعة كفر الشيخ لدراسة تأثير كل من نوعية المياه المستخدمة واستخدام التغطية بقش الارز ومعدلات رى مختلفة على الانتاجية – انتاجية المياه – انتاجية النيتروجين وعوامل المحصول الاخرى للكرنب باستخدام نظام الرى بالتنقيط وكانت عوامل الدرسة كالتالى:

نوعية المياه : مياه الرى العادية – مياه صرف مزارع السمك

معدل الرى : ١٠٠% ، ٨٠% ، ٦٠% من الحتياجات المائية للمحصول

نظم التغطية : تغطية باستخدام قش الارز – بدون تغطية

وكانت أهم النتائج مايلى:

- بصفة عامة وبغض النظر عن تأثير التغطية ومعدل اضافة المياه فأن الرى بمياه صرف احواض السمك اعطى افضلية لكل من الصفات المحصولية المختلفة متمثلة فى الانتاجية ، قطر الرأس للكرنب ، ارتفاع الرأس وكذلك انتاجية الوحدة من المياه.
- الرى بماء صرف احواض السمك ادى الى زيادة انتاجية الكرنب بنسب ٤٩,٣، ١,٧ ، ٣٠,٦ % عند مستويات اضافة ١٠٠ ،٨٠ ، ٦٠ % على الترتيب.
- أعلى انتاجية لمحصول الكرنب تم الحصول عليها من معاملة الرى بماء صرف احواض السمك بقيمة مقدارها ١٩٧,٥ ميجاجرام / هكتار.

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- المعاملات التى احتوت على الرى بماء صرف السمك مع التغطية بقش الارز بمعدل اضافة مياه ١٠٠% اعطت اعلى انتاجية للمياه (٣٦,٧ كجم/م٣) بينما المعاملات التى تم ريها بمياه الرى العادية بدون تغطية بقش الارز بمعدل اضافة مياه ٨٠% اعطت اقل انتاجية للمياه (١٥,٥ كجم/م٣).
- الرى بماء صرف احواض السمك ادى الى زيادة انتاجية المياه للكرنب بنسب ١٦,١ ،٢٧,٦ ، ٢٤,٦ % عند مستويات اضافة ١٠٠ ،٨٠ ، ٦٠ % على الترتيب.
- أوضحت الدراسة ايضا ان التغطية بقش الارز ساعد على زيادة معدل النمو والاستفادة من المياه والتسميد حيث سجلت المعاملات التى اشتملت على التغطية قيم اعلى مقارنة بالمعاملات التى لا تحتوى على تغطية.

يتضح من هذه الدراسة ان استخدام مياه صرف للمزارع السمكية يمكن ان يكون مصدر امن لمياه رى المحاصيل الورقية كالكرنب حيث ادى استخدام هذه المياه الى زيادة انتاجية الكرنب وكذلك انتاجية النيتروجين لما تحتويه هذه المياه من عناصر غذائية كذلك من الناحية الاقتصادية تعتبر طريقة جيدة وذات عائد عند النظر للتوفير فى كميات الاسمدة المستخدمة.