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MAXIMIZE WATER PRODUCTIVITY USING AQUACULTURE WATER FOR SESAME CROP UNDER DRIP IRRIGATION SYSTEMS

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ABSTRACT: Aquaculture has become an important economic activity in many countries, so the main aim of the present research is to study the effect of using aquaculture drainage as non-traditional source for promoting sesame crop yield. Experiments were carried out on sesame crop in sandy soil of Wadi El-Natroon using two water resources (well and aquaculture) with different nitrogen fertilizer ratios (20, 60 and 100%) under drip irrigation systems (surface and subsurface). The effect of previous parameters was evaluated in terms of the amount of applied water, water use efficiency, nitrogen use efficiency, crop characteristics (capsule number/plant, plant length, total seed yield) added to economic analysis. Experimental results revealed that aquaculture drainage gave the best results in all aspects compared to the use of well water. Water use efficiency was increased by increasing nitrogen fertilizer rate, while *vice versa* was observed with nitrogen use efficiency. The optimum obtained conditions for sesame crop were noticed by using aquaculture drainage with 60 % nitrogen fertilizer rate resulting in 40% fertilizer saving comparing with well water. These previous conditions gave (0.21 and 0.2 kg/m^3) water use efficiency, (5.11 and 4.61 kg/kg) nitrogen use efficiency, (465.33 and 418.33 kg/fad.) crop yield with (10983 and 10093 LE/fad.) net return and (5.01 and 4.91 LE/m^3) water productivity for surface and sub-surface irrigation systems, respectively.

Key words: Aquaculture drainage, sesame crop, drip irrigation systems, water use efficiency, nitrogen use efficiency, crop yield.

INTRODUCTION

Water security as an indicator of food security is the biggest challenge facing world and it is an important strategic goal that all water policies seek to achieve. Nowadays, water resources are limited in many regions; so the irrigation systems are applied under stress in order to improve water use efficiency. Using modern irrigation systems to develop the irrigated agriculture lands depends not only on shortage water being available, but also the appropriate use of that water. Drip irrigation is a more efficient irrigation method to improve irrigation performance because of its high uniformity. The drip irrigation system may have application efficiencies between 70–90% as surface runoff, added to deep percolation losses and evaporation are minimized **(Postel, 2000)**. The net crop yield increased under drip system as compared to that obtained from surface irrigation system. **Abdel-Moneim and Salem, (2014)** found that, the subsurface drip irrigation caused a significant increase in growth and yield of potato crop comparing with surface drip irrigation system. **Gaafar *et al.* (2014)** reported that the highest seed, oil and straw yield (403, 244.2 and 1815 kg/fed.) were obtained using surface drip irrigation. Actual irrigation water requirement under surface and subsurface drip irrigation systems for sesame was 2005 and 1892 m^3/fad., respectively. **Eid *et al.* (2017)** found that applied subsurface drip irrigation was saving the water by of 5.35 and 7.3% in

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comparison with using surface drip irrigation system, under nili and summery seasons, respectively. The water productivity and production for subsurface drip irrigation treatments gave the highest values comparing with surface drip irrigation treatment. **Yeşim *et al.* (2018)** found that subsurface drip used slightly less water than the surface drip due to reduced evaporation losses from the soil surface. Results showed that surface drip resulted in higher eggplant yield than subsurface drip.

With regard to the effect of reuse aquaculture drainage in irrigation, **Edwards *et al.* (2002)** suggested that poor farmers are generally not early adopters of aquaculture technologies and that aquaculture only becomes an option given certain predisposing conditions. Reuse drainage water of fish farming as a new resource for irrigation and rich with organic matter can improve soil quality and crops productivity. In addition to reduce the total costs of fertilizers by adding minimum doses from minerals fertilizers and reduce the pollution in soil. **Hamoda (2004)** stated that water reuse is a cost-effective alternative in the development of water resources, since it can be provided at less than half of the cost of producing desalinated water. **Abdelraouf and Hoballah (2014)** found that potato yield and water use efficiency were 8 Mg/fad. and 2.9 kg/m^3 under drainage water of fish farms compared to 7.8 Mg/fad. and 2.9 kg/m^3 under traditional irrigation water. **Okasha *et al.* (2016)** concluded that drainage water of fish farms increased soybean yield and water productivity comparing with canal fresh under sprinkler irrigation system. **Motaka *et al.* (2016)** mentioned that Nitrogen such as proteins and nucleic acids is the essential nutrient for many vital processes. **Abdelraouf and Ragab (2017)** stated that use of drainage water of fish farms instead of fresh water for irrigation of wheat could help to achieve higher yields while using less irrigation water and less chemical fertilizers**.** **Attafy and Elsbaay (2017)** found that using fish effluents and drip irrigation system under different nitrogen fertilization levels and fish drainage water led to higher lettuce yield, nitrogen productivity.

A relationship was found between the nitrogen fertilizer dose and the yield of any crop**,** **Noor (2017**) mentioned that before making recommendations for the nitrogen fertilizer dose for any crop, one should evaluate the efficiency and optimum rate for different application levels for better growth and yield performance. **Belete *et al.* (2018)** showed that the optimum grain yield (6060.04 kg/ha) was recorded when 240 kg N/ha was applied and it showed no significant additional response to N fertilizer above this rate. Higher N level (360 kg N/ha) always increased N content in the grain and nitrogen uptake by wheat crop. The best recovery of nitrogen (59.74%) by wheat was found when 120 kg of nitrogen was applied (¼ at sowing, ½ at tillering and ¼ at booting). The nitrogen use efficiency traits decreased with increasing N rate (120–360 kg N/ha). The split application of nitrogen (¼ at sowing, ½ at tillering and ¼ at booting) produced the highest nitrogen use efficiency traits. **Gewaily *et al.* (2018)** observed a linear increase in grain yield with continuous rate increase of nitrogen from 0 to 220 kg/ha, while 220 kg N/ha treatment showed maximum grain yield followed by 165 kg N/ha with control as minimum. **Moursy (2018)** found that the highest net return and the maximum value of water productivity were 8427 LE/fd. and 3.53 LE/m^3 with using agri-aquaculture, while the lowest value was 6144 LE/fad. and 2.32 LE/m^3 with using well water.

Egypt has still no clear strategy for using non-traditional sources of irrigation. Drainage water of fish farms (aquaculture) is one of these sources, which is rich with organic matter and nitrogen fertilizer. So, the objectives of the present study are to

1- Study the effect of aquaculture as non-traditional resource on sesame yield.

2- Compare the performance of non-traditional source (aquaculture water) with traditional source (well water) to determine their impacts on water and fertilizer use efficiency.

3- Evaluate the used surface and subsurface drip irrigation systems from the economic point of view.

MATERIALS AND METHODS

Materials

The present study was conducted at the experimental station of National Water Research Centre, Wadi El-Natroon, El-Behira Governorate, Egypt. Field experiments were carried out through the period from 5th June 2018 to 5th October 2018 to find out the effect of using nontraditional source of irrigation (Agri-aquaculture) on the efficiency of surface and subsurface drip irrigation systems and sesame yield. Experiments were executed on sandy soil, the soil properties were 1.56 g/cm^3 bulk density, 9.3% field capacity, 3.1% permanent willing point and 6.2% available water.

Crop

Sesame (*Sesame indicum* L.) crop was sown manually on 5th June 2018 at the rate of 4 kg/fad., while harvesting was occurred on the 5th October 2018. Fertilizer needs for sesame crop were added as follow: 200 kg/fad. (15.5% P_2O_5) Superphosphate was added at the beginning of soil preparation, 50 kg/fad. (48% K_2O) Potassium sulfate was divided in two doses as one after thinning and the other after 15 days of thinning and 150 kg/fad. (20.5% N) Ammonium was divided into three doses and added after thinning, 30 and 60 days of thinning.

Water Resources

Well water and Aquaculture drainage were used as water resources under the present study. Aquaculture contains Tilapia fish type with about 10000 fish quantity. The period of experimental aquaculture was started from 15th April to 15th Oct. Water amount in aquaculture system was in the range of about 10-25% of total water amount every day depending on fish age. While, well water as a second water resource was 144 m in depth with discharge rate of about 85 m^3/hr. The properties of two water resources were shown in Table 1.

Drip Irrigation Systems

Surface and sub-surface drip irrigation systems were used under this study. The drip irrigation system consisted of control head (centrifugal pump, pressure regulator, pressure gauges, flow meter and filters) as shown in Fig. 1. The used PVC pipes were 110, 75 and50 mm in diameters for main, sub-main and secondary lines, respectively. Laterals drip GR lines made of polyethylene pipes with 16 mm diameters, 30 cm emitters distance with 4 l/hr. emitter's discharges. The used emitters type was GR, either placed on soil surface for surface irrigation system or buried approximately 15 cm deep directly under the soil beds for sub-surface irrigation system. The sub-main line was equipped with a valve, meter and a pressure gauge. The lengths of laterals and spacing between them were 20 and 0.7 m, respectively. The irrigation system was connected with combination of screen and sand filters to maintain the system from impurities. The screen filter was 135 cm length and 25.4 cm tank diameter with 100 m^3/hr. maximum discharge. While, the used sand filter media treatments contain sand media with 1.89 bulk density g/cm^3 and 43.2% porosity.

Methods

Experimental Setup

A split split plot experimental design was used, with three replications. Field experiments were carried out under the following variables:

- Two water resources (Aquaculture drainage and well water).
- Two drip irrigation systems (surface and sub-surface).
- Three nitrogen fertilizer rates (20, 60 and 100% N).

Measurements

The following measurements were done to evaluate the effect of previous experimental parameters as:

Amount of applied water

Amount of applied water was calculated under each irrigation system using the following equation:

$$A_W = \frac{((\theta_{FC} - \theta_V) \times d) + L_f}{E_s} \quad ....(1)$$

Where:

A_W: Amount of applied water, mm/intervals, θ_{FC}: Soil moisture content at field capacity (%) by volume, θ_v: Soil moisture content (%) under soil condition by volume, d: Depth of soil layer (25 cm), Es: System efficiency, % and L_f: Leaching factor under drip irrigation system, this factor was calculated using the following equation:

Table 1. Properties of the used water resources under study

Resource	pH	TDS (mg/l)	Total phosphate (mg/l)	NO_3 (mg/l)
Aquaculture	7.52	1750	0.17	66.4
Well	7.78	1450	0.1	2.6

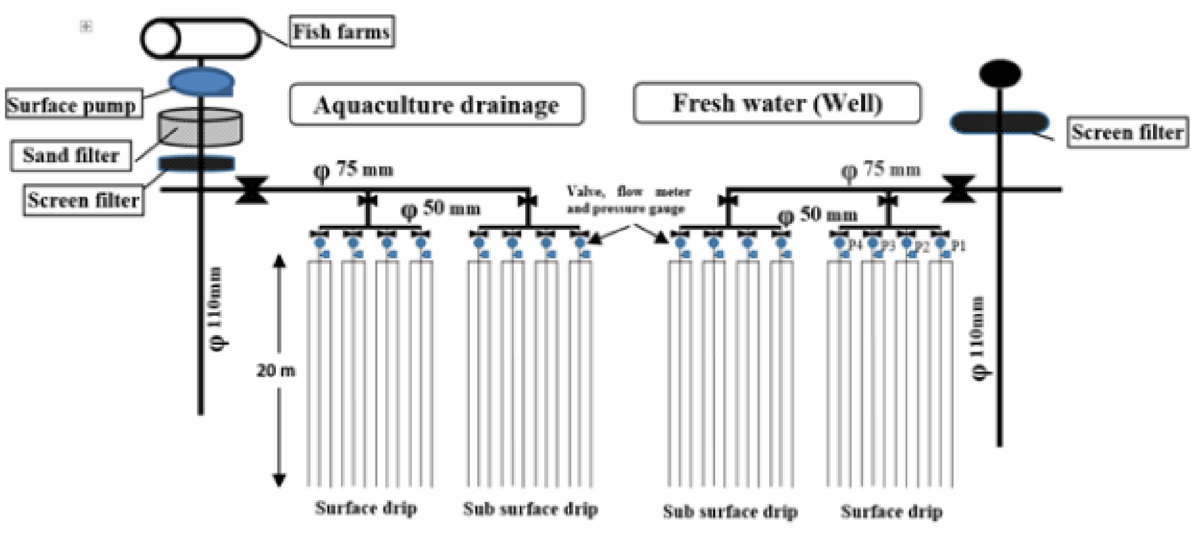

Fig.1. Schematic of the used drip irrigation systems

$$L_f = \frac{EC_w}{2ma \times EC_e} \quad ......(2)$$

Where:

EC_w: Salinity of the applied irrigation water, dS/m and Ec_e: Average soil salinity tolerated by the crop as measured on soil saturation extract, dS/m.

Water use efficiency

Water use efficiency (WUE, kg/m^3) was used to evaluate the effect of various treatments. It was calculated according to **(Pene and Edi, 1996)** using the following equation:

$$WUE = \frac{\text{Sesam yield}\left(\frac{kg}{fad.}\right)}{\text{Amount of water applied}\left(\frac{m^3}{fad.}\right)} \quad ...(3)$$

Nitrogen use efficiency

The nitrogen use efficiency (NUE, kg seeds/ kg of nitrogen fertilization) was determined according to **Vites (1965)** as:

$$NUE = \frac{\text{Sesam yield}\left(\frac{kg}{fad.}\right)}{\text{Nitrogen fertilizer application}\left(\frac{kg}{fad.}\right)} \quad ...(4)$$

Yield and its components

Some properties of sesame crop were determined under different treatments as capsule number/plant, plant length (cm) and total seed yield (kg/fad.).

Economic analysis

Economic analysis was conducted to determine the optimum economic conditions of water productivity for sesame crop of two water resources under different drip irrigation systems with different nitrogen fertilizer rates.

Total production costs (PC, LE/fad.) was calculated with the following equation:

PC= Fish farm costs + Irrigation system costs + Agricultural operation costs … (5)

Total return (TR, LE/fad.): was calculated with the following equation:

TR=Total return of crop+Total return of fish..(6)

Total return of crop = Crop price (LE/kg) × Grain yield (Mg/fad.). ...(7)

Total return of fish = Fish price (LE/kg) × Fish yield (Mg/fad.)....(8)

Net return (NR, LE/fad.) was calculated by:

NR = TR - PC ……………...…(9)

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

$$WP = \frac{NR\ (LE/Fad.)}{Amount\ of\ water\ applied \left(\frac{m^3}{fad.}\right)} \quad ...(10)$$

RESULTS AND DISCUSSION

Amount of Applied Water

Comparing the effect of using two water resources under drip irrigation systems, obtained results in Fig. 2 illustrate that aquaculture drainage gave higher amount of applied water than well water. This may be due to the increase in salinity concentration of aquaculture drainage and thereby, the leaching factor was increased, resulting in high amount of applied water of aquaculture drainage than well water.

With regard to the effect of drip irrigation systems, obtained results showed that surface irrigation consumed more amount of applied water than subsurface irrigation system. By the use of well water and aquaculture drainage, the values were 2083 and 2190 m^3/fad., for surface irrigation system, while 1957 and 2057 m^3/fad., for subsurface irrigation system, respectively. These results are in agreement with those obtained by **Kassab *et al.* (2005) and Gaafar *et al.* (2014)**.

Water Use Efficiency

Fig. 3 showed the effect of using water resources with different fertilizer rates under surface and subsurface irrigation systems on water use efficiency (WUE).

Results clarified that aquaculture drainage gave higher values of WUE than well water. Because the rate of increase in sesame yield was higher than the increase rate in amount of water applied using aquaculture drainage. At 60% N with well water and aquaculture drainage, WUE values were 0.20 and 0.21 kg/$m^3$for surface irrigation system, while valued as much as 0.19 and 0.20 kg/$m^3$for subsurface irrigation system, respectively.

Respecting to effect of drip irrigation systems under different fertilizer rates, results explained that subsurface irrigation system gave lower values of WUE than surface irrigation system due to the decrease in the amount of applied water with subsurface system. In addition, WUE was increased by increasing fertilizer rates from 20 to 100%. This increase was attributed to the increase in sesame yield. Using surface irrigation, the values were 0.17, 0.20 and 0.22 kg/$m^3$for well water, while they were 0.18, 0.21 and 0.22 kg/m^3 for aquaculture drainage under 20, 60 and 100% N fertilizer rates, respectively. These results are in agreement with those obtained by **Kassab *et al.* (2005) and Gaafar *et al.* (2014)**.

Nitrogen Use Efficiency

Effect of different treatments on nitrogen use efficiency (NUE) was illustrated in Fig. 4. Obtained results indicated that aquaculture drainage gave higher results comparing with well water resource. The NUE values were 11.48, 4.56 and 3.09 kg/kg for well water as well as 13.00, 5.11 and 3.31 kg/kg for aquaculture drainage for surface irrigation under 20, 60 and 100% N, respectively. However, using subsurface irrigation, the values were 10.36, 4.11 and 2.78 kg/kg for well water as well as 11.66, 4.61 and 3.01 kg/kg for aquaculture drainage under the same previous conditions, in that order.

Results explained that surface irrigation outperformed on subsurface system in NUE. This is regarding to the highest obtained sesame seed yield under surface irrigation comparing with subsurface irrigation system. These results are in agreement with those obtained by **Noor (2017) and Gewaily *et al.* (2018)**.

With increasing the fertilizer percentage, increased the quantity, which reflected on decreasing NUE and thereby the highest NUE was obtained by 20% N.

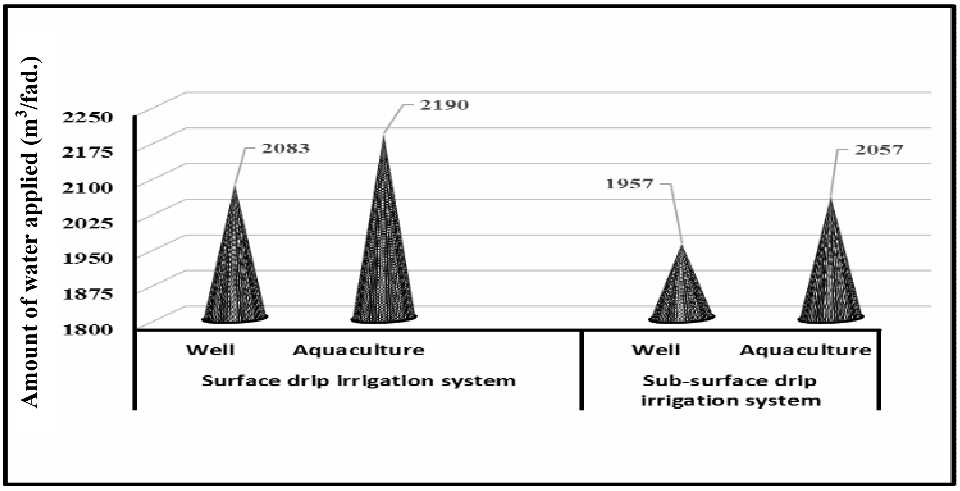

Fig. 2. Effect of water resources and drip irrigation systems on amount of applied water

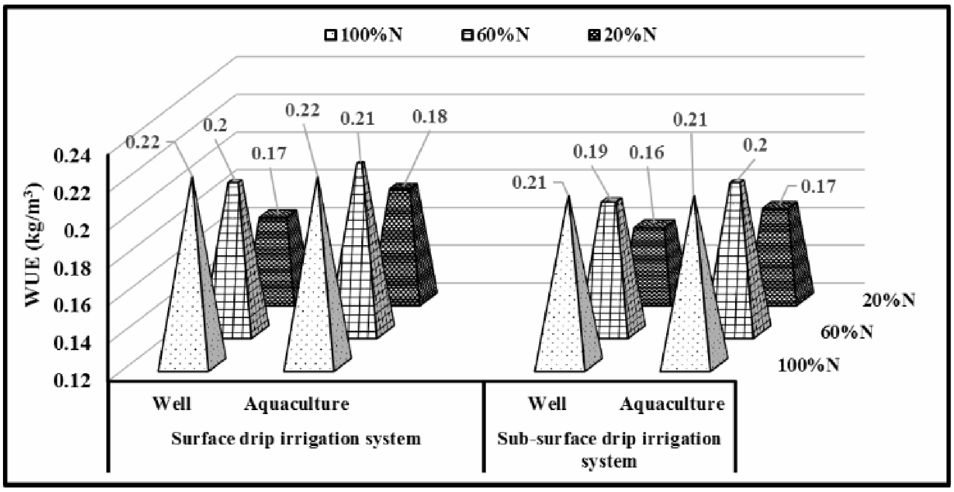

Fig. 3. Effect of water resources under drip irrigation systems on water use efficiency

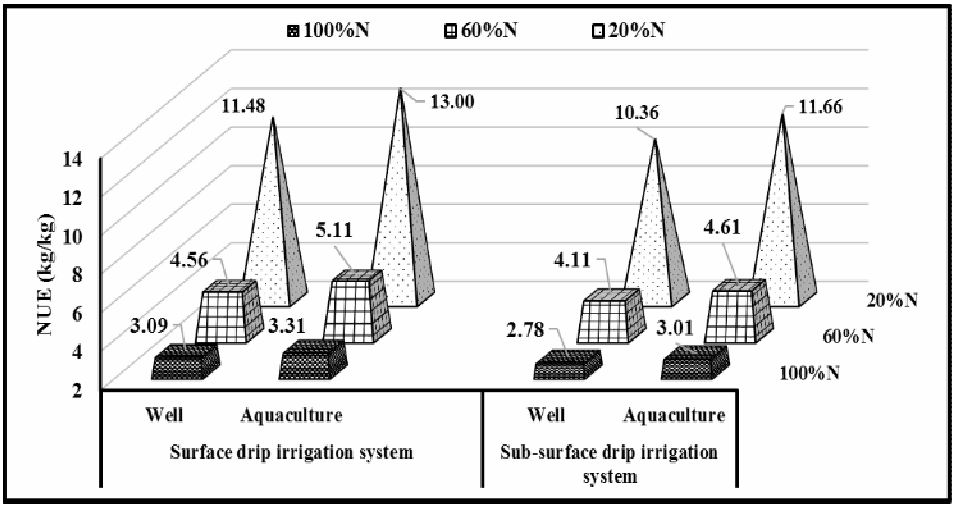

Fig. 4. Nitrogen use efficiency using different water resources under drip irrigation systems

Sesame Crop Yield and its Components

Table 2 show sesame crop yield and its components under different treatments. Results revealed that the use of aquaculture drainage enhanced all sesame crop characteristics compared to well water. At 100% N, the highest conditions of capsule number (48.67 and 53.67), plant length (156.67 and 167.67 cm) and seed yield (463 and 482 kg/fad.) were obtained for well water and aquaculture drainage under surface irrigation system, while capsule number (45.33 and 50.33), plant length (145.33 and 154.33 cm) and seed yield (417.33 and 434.67 kg/fad.) were obtained under subsurface irrigation system for well water and aquaculture drainage, respectively. These results are in agreement with those obtained by **Attafy and Elsbaay (2017), Moursy (2018) and Elmetwalli and Amer (2019)**.

Concerning the effect of irrigation systems, it was cleared that surface irrigation system gave the highest sesame characteristics than subsurface irrigation.

Increasing nitrogen fertilizer rate to be 100% of recommended dosage boosted all sesame characteristics comparing with other percentages. These findings coincide with those stated by **Noor (2017) and Gewaily *et al.* (2018)** who found that increasing nitrogen fertilizer rate was advantageous for crop production.

Economic Analysis

With evaluating the economic analysis of different treatments, Table 3 showed that the highest net return with water productivity was obtained under surface irrigation system compared to subsurface irrigation system. The highest values of net profit of 10983 and 10093 LE/fad., with water productivity of 5.01 and 4.91 LE/m^3 were obtained under using aquaculture drainage with fertilizer rate of 60% for surface and subsurface drip irrigation systems, respectively. These results are in agreement with those obtained by **Moursy (2018)**.

Table 2. Yield and its components of sesame crop under different treatments

Treatment				Sesame crop characteristics		
				Capsule number/plant	Plant length (cm)	Seed yield (kg/fad.)
Surface irrigation system	Water resources	Well	20% N	37.67	132.67	344.33
			60% N	42.67	141.67	410.33
			100% N	48.67	156.67	463.00
		Aquaculture	20% N	42.33	140.33	390.00
			60% N	48.33	149.33	465.33
			100% N	53.67	167.67	482.00
Sub-surface irrigation system	Water resources	Well	20% N	35.33	127.33	310.67
			60% N	39.33	134.33	370.00
			100% N	45.33	145.33	417.33
		Aquaculture	20% N	40.67	133.33	349.67
			60% N	45.33	140.67	418.33
			100% N	50.33	154.33	434.67

Table 3. Economic analysis of sesame crop under different treatments

Treatment				Economic analysis			
				Total production costs (LE/fad.)	Total return (LE/fad.)	Net return (LE/fad.)	Water productivity (LE/m^3)
Surface irrigation system	Water resources	Well	20% N	2460	6887	4427	2.13
			60% N	2960	8207	5247	2.52
			100% N	3460	9260	5800	2.78
		Aquaculture	20% N	12224	22200	9976	4.56
			60% N	12724	23707	10983	5.01
			100% N	13224	24040	10816	4.94
Sub-surface irrigation system	Water resources	Well	20% N	2410	6213	3803	1.94
			60% N	2910	7400	4490	2.29
			100% N	3410	8347	4937	2.52
		Aquaculture	20 % N	12174	21393	9219	4.48
			60% N	12674	22767	10093	4.91
			100% N	13174	23093	9919	4.82

Conclusion

Water security as an indicator of food security is the biggest challenge facing world, so reuse of the aquaculture drainage comparing to traditional source of well water for promoting sesame crop yield is the main objective of the present study.

Experimental results revealed that:

1- Aquaculture drainage gave best results in all aspects compared to well water.

2- Water use efficiency was increased by increasing nitrogen fertilizer rate, while *vice versa* was observed with nitrogen use efficiency.

3- The optimum obtained conditions for sesame crop were noticed by using aquaculture drainage with 60% nitrogen fertilizer rate and so, 40% fertilizer saving compared to traditional methods.

4- Using aquaculture drainage with 60% N gave 0.21 and 0.2 kg/m^3 water use efficiency, 5.11 and 4.61 kg/kg nitrogen use efficiency, 465.33 and 418.33 kg/fad., crop yield with 10983 and 10093 LE/fad., net return and 5.01 and 4.91 LE/m^3 water productivity for surface and sub-surface irrigation systems, respectively.

REFERENCES

Abdel-Moneim, S.K. and A.A. Salem (2014). Effect of two drip irrigation methods (surface and subsurface) in growth and yield of three potato (*Solnum tuberosumI*) Cultivars. Aust. J. Basic and Appl. Sci., P: 252 – 258.

Abdelraouf, R.E. and E.M.A. Hoballah (2014). Impact of irrigation systems, fertigation rates and using drainage water of fish farms in irrigation of potato under Arid Regions conditions. Int. J. Sci. Res. Agric. Sci., 1 (5): 67-79.

Abdelraouf, R.E. and R. Ragab (2017). The benefit of using drainage water of fish farms for irrigation: field and modeling study using the saltmed model. Irrig. and Drain., 66: 758 – 772.

Attafy, T.M. and A.M. Elsbaay (2017). Integrated management of fish (Nile Tilapia) and leaf vegetable crop (head lettuce) culture under drip irrigation system. Misr J. Agric. Eng., 35 (1): 105-124.

Belete, F., N. Dechassa, A. Molla and T. Tana (2018). Effect of split application of different N rates on productivity and nitrogen use efficiency of bread wheat (*Triticum aestivum* L.). Agric. and Food Security, 7: 92.

Edwards, P., D.C. Little and H. Demaine (2002). Issues in Rural Aquaculture. Rural Aquaculture. CABI Publishing, 323-340.

Eid, S.F.M., S.M. Tarek and E.A. El-Samra (2017). Irrigation scheduling of potato to increase the water productivity under drip irrigation system on sandy soil. J. Soil Sci. and Agric. Eng., Mansoura Univ., 8 (12).

Elmetwalli, A.H. and M.M. Amer (2019). Effect of using fish basins drainage water, mulching and watering regime on cabage crop properties under drip irrigation system. Misr J. Agric. Eng., 36 (2): 457 – 472.

Gaafar, I., M.A.M. Moursy, A. AbouKheira and N.S. Abdel Kareem (2014). Impact of deficit irrigation on yield of sesame in sandy soil. Egypt. J. Appl. Sci., 29 (10): 1026-1041.

Gewaily, E.E., A.M. Ghoneim and M.M.A. Osman (2018). Effects of nitrogen levels on growth, yield and nitrogen use efficiency of some newly released Egyptian rice genotypes. Open Agric., 3: 310–318.

Hamoda, M.F. (2004). Water strategies and potential of water reuse in the south Mediterranean countries. Desalination, 31-41.

Kassab, O.M., A.A. El-Noemani and H.A. El-Zeiny (2005). Influence of some irrigation systems and water regimes on growth and yield of sesame plants. J. Agron., 4 (3): 220–224.

Motaka, G.N., D.J. Paramar and J.S. Patel (2016). Response of sesame (*Sesamum indicum* L.) to organic and inorganic sources of nitrogen in light textured soils of semiarid Bhal region. An Int. Quarterly J. Life Sci., 11 (3): 1653-1658.

Moursy, M.A.M. (2018). Influence of agri-aquaculture and seed treatment techniques on sugar beet crop. J. Soil Sci. and Agric. Eng., Mansoura Univ., 9(1): 63 – 68.

Noor, M.A. (2017). Nitrogen management and regulation for optimum NUE in maize–A mini review. Cogent Food and Agric., 3 : 1.

Okasha, E.M., A. Ramadan, M.A. El-Shawadfy and H.H. Tarabye (2016). Integrated management for drainage water of fish ponds in agriculture using sprinkler irrigation system. Res. J. Pharm., Biol. and Chem. Sci., 7 (3): 595-605.

Pene, C.B.G. and G.K. Edi (1996). Sugarcane yield response to deficit irrigation at two growth stages. In: Nuclear Techniques to Assess Irrigation Schedules for Field Crops. IAEA, TECDOC 888, 115-129, Vienna.

Postel, S. (2000). Redesigning irrigated agriculture. In: Starke, L. (Ed.), State of the World. W.W. Norton and Co., New York, 39–58.

Vites, F.G. (1965). Increasing water use efficiency by soil management. Ame. Soc. Agron., Madison, Wisconsin, 259-274.

Yeşim, B.Ç., A. Yazar, E. Gonen and E.C. Eroglu (2018). Yield and quality response of surface and subsurface drip-irrigated eggplant and comparison of net returns. Agric. Water Manag., 206: 165-175.

تعظيم إنتاجية المياه باستخدام مياه الاستزراع السمكي لمحصول السمسم تحت أنظمة الري بالتنقيط

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قضية الأمن المائي تعتبر مؤشر للأمن الغذائي وتمثل التحدى الأكبر التي تواجهه مصر، ويعتبر تحقيق الأمن المائي في الحاضر والمستقبل هدفاً استراتيجياً هاماً تسعى إلى تحقيقه كافة السياسات المائية، تشير الدراسات والتقديرات لكميات المياه المتاحة والاحتياجات المائية للأغراض المختلفة، إلى تقليل الفجوة بين العرض والطلب علي المياه لذا لابد من البحث عن طرق غير تقليدية لتعظيم العائد من وحدة المياه ويتمثل ذلك في استخدام المياه الناتجة من صرف المزارع السمكية لرى المحاصيل والتي تحتوى على مستويات عالية من النيتروجين وبالتالي تقليل كمية الأسمدة الكيماوية المستخدمة، أما بالنسبة لتطوير منظومة إدارة المياه على مستوى المزرعة فيتمثل في استخدام نظم رى عالية الكفاءة كنظام الرى بالتنقيط لتوفير كميات مياه الرى المضافة للمحاصيل ورفع كفاءة استخدام المياه، لذلك كان الهدف هو دراسة تأثير استخدام المياه الناتجة من الاستزراع السمكى كمصدر غير تقليدي لتعظيم إنتاجية محصول السمسم والعائد من وحدة المياه، أجريت الدراسة بمحطة بحوث وادى النطرون – معهد بحوث إدارة المياه – المركز القومى لبحوث المياه خلال الموسم الصيفى ٢٠١٨م، كانت عوامل الدراسة هي نوعين مختلفين من مياه الرى (مياه الآبار–مياه صرف الإستزراع السمكى) وذلك باستخدام نظامين مختلفين للرى بالتنقيط (سطحى وتحت سطحى) تحت مستويات مختلفة من التسميد النيتروجينى (٢٠ ، ٦٠، ١٠٠%)، وقد تم تقييم التجربة من خلال أخذ عدة قياسات مرتبطة بالعلاقات المائية، صفات المحصول ، التحليل الإقتصادى، وكانت أهم النتائج المتحصل عليها: المياه الناتجة من صرف الاستزراع السمكى حققت أفضل النتائج تحت جميع المعاملات مقارنة بالمياه العذبة (بئر مباشرة)، أعطى نظام الرى بالتنقيط السطحى أفضل النتائج تحت جميع المعاملات بالمقارنة بنظام الرى بالتنقيط تحت السطحى، كفاءة إستخدام المياه تزيد بزيادة معدل التسميد النيتروجينى بينما على العكس قلت كفاءة إستخدام السماد النيتروجيني، أوضحت النتائج أنه يمكن تعظيم زراعة محصول السمسم باستخدام المياه الناتجة من الإستزراع السمكى مع معدل سماد النيتروجين ٦٠% تحت نظامى الرى بالتنقيط السطحى وتحت السطحى وكانت قيم كفاءة إستخدام المياه (٠,٢١ و ٠,٢ كجم/م^3) وكفاءة إستخدام النيتروجين (٥,١١ و ٤,٦١ كجم/كجم) إنتاجية محصول الحبوب (٤٦٥,٣٣ و ٤١٨,٣٣ كجم/فدان) وكانت صافى العائد (١٠٩٨٣ و ١٠٠٩٣ جنيه/فدان) والعائد من وحدة المياه (٥,٠١ و ٤,٩١ جنيه/م^3) على التوالي، بالإضافة أنه قلل من كمية السماد المستخدمة بنسبة ٤٠%، اتضح من الدراسة: أنه يمكن إستخدام المياه الناتجة من عملية صرف الإستزراع السمكى كمصدر غير تقليدى وآمن لمياه الرى وكذلك كمصدر من مصادر الأسمدة النيتروجينية الغير التقليدية.

المحكمـــــون:

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