DJAS., Vol. (3) (1): (114 -123) (2024)

Damietta Journal of Agricultural Sciences
http://publication.du.edu.eg/journal/ojs302design/index.php/agr/index
ISSN: 2812-5347(Print)- 2812-5355 (Online)

Effect of inlet water temperature on the uniformity parameters of drip irrigation system

Elnemr[1], M. K. and Abo-Elatta, N.R. A.[2]

[1] Professor, Agric., and biosystems, Eng., Dept., Fac. of Agric., Damietta Univ., Damietta, Egypt.

2. M.Sc. researcher, Agric., and biosystems, Eng., Dept., Fac. of Agric., Damietta Univ., Damietta, Egypt.

Email address: moknemr@du.edu.eg، **Mobile no. 01101007863**

Corresponding author*: engnoor260180@gmail.com, **Mobile no.01026998658**

ARTICLE INFO

Key words: Drip Irrigation, Uniformity parameters, Operating Pressure, Water Temperature, Emitter types.

ABSTRACT

The objective of this research study was to investigate the effect of inlet water temperature on drip irrigation system uniformity. The experimental work was held under laboratory conditions, whereas a model for a drip irrigation system was used to follow the effect of increased irrigation water temperature on uniformity parameters. The variables of this study were water temperature (T) with five levels namely 20, 25, 30, 35, and 40 °C three operating pressure heads (H) which were 10, 15, and 20 m of water with two types of emitters named A and G. Uniformity parameters under study included uniformity coefficient (UC), emission uniformity (EU), Manufacturing coefficient of variation (CV), and emitter flow rate variation (q_{avr}). The results showed that increasing inlet water temperature will lead to mean flow rate for both emitters at all pressure heads. The increase in water temperature led to improve the uniformity levels of drip irrigation system for both emitter types. The two emitters' drip lines showed different response for the operation heads as the best performance for G emitter laterals was at 20m head while it was 10m for A emitter. Effect of water temperature on uniformity was clear as it improved the corresponding classification for both UC and EU with the two emitters' drip lines. T_{40} is recommended for the two emitters types. The effect of high levels of water temperature on plants should be deeply investigated to avoid the negative possible ones.

1. INTRODUCTION

Drip irrigation is known as one of the most water-saving irrigation systems as it provides water to the plants directly to the root zone with small amounts of water. Compared to furrow irrigation, drip irrigation technology can reduce irrigation water usage by 25% **(Aujla et al., 2007)**, and increasing water use efficiency **(Ibragimov et al., 2007)**. When compared to sprinkler irrigation, drip irrigation is distinguished by the application of water consistently and precisely at a high watering frequency **(Hanson and May 2007)**. Crop yield and quality is essential target for farmers **(Abd El- Baset, et al., 2017),** as we need it is necessary to apply drip irrigation system in an effective way to conserve more water **(El-Habbasha et al., 2014)**. The main characteristic of a drip irrigation system is the ability to distribute water uniformly, which is one of the most crucial factors in developing, administering, and using this system. A well-managed and designed drip irrigation system provides each plant with roughly equal amounts of water, preserving uniformity, satisfying its water needs, and being economically viable **(Acar et al., 2010 and Omofunmi et al., 2019)**. Poor management of irrigation systems result in non-uniform water distribution specially especially at the end of laterals which reduces water distribution efficiency **(Abdelraouf et al., 2020)**. Emitter is responsible for water distribution in drip irrigation system. It should be selected to give the greatest possible performance. (**El-Nemr, 2010)** recommended moving away from the use of emitters that shows poor levels of uniformity parameters because of the negative impact on crop yield. Variation in emitters' flow rates along laterals reflects how uniform is water distributed along laterals. The main causes of emitters discharge variations along drip irrigation laterals are mainly due to manufacturing variations, pressure differences, and changes in irrigation water temperature resulting in flow rate variations even between two identical emitters **(Kumar and Ashoka, 2020)**. Operating the pressure head is one of the most important factors for successful drip irrigation system management (**Hezarjaribi et al., 2008; Alabas, 2013;** and **EL-Nemr, 2013)**. Since it affects the drip system uniformity parameters. Every emitter type of emitter shows its best performance at a certain operation head. With a closer sight, the temperature of irrigation water influences the emitters `s discharge in various ways in which, geometric form, the constituents and the flow duct in emitter can be changed under the temperature variations and influence the output discharge **(Rodrı´guez-Sinobas, 1999, Clark et al., 2005 and Alizadeh, 2010)** .The other effect is due to its influence of temperature on water viscosity so that the Kinematic viscosity decreased as the temperature goes up and, so the emitters` discharge would be increased. The discharge changes to viscosity of water depend on the in-emitter discharge controlling condition. Referring to the previous studies, inlet water temperature can significantly affect the hydraulic performance of drip irrigation system, so we it is important should to study its effect on system's uniformity with different pressure heads. The objectives of this study were as follows: 1- Investigate the effect of inlet water temperature on the uniformity of the drip irrigation system, 2- follow the change in different uniformity parameters as affected by both pressure and emitter type.

2. MATERIAL AND METHODS

2.1 Materials

2.1.1 Experiment area description and drip irrigation system network layout

The experiment was conducted in a private house in in Umm Al-Rida village (31˚ 24ˈ N - 31˚ 37ˈ E), Kafrelbatikh city, Damietta governorate, Egypt, during the period from August to September 2021. Dimensions of the experiment area was 12*8 m^2. A small-scale model of drip irrigation was used to evaluate the effect of inlet water temperature on drip irrigation system uniformity. Built-in emitters of 30cm spacing in polyethylene lateral were used. Average of three replicates of the lateral was used to express the results of each measurement. Components of the network were are as shown in figure 2.

1. Water plastic tank of 50-liter capacity for storing water, with 37 cm base diameter, 40 cm diameter in the middle, and a tank height of 57 cm.
2. 500W RS-399 electrical aquarium stainless-steel heater was used to control water temperature. The range of the heater temperature was 12 to 35 ^{o}C. A hole was made for the thermometer on the right side of the tank and it has two holes from the top, one for the intake hose and the other for the water heater. It was covered with aluminum to maintain the water temperature.
3. 16 mm inner diameter polyethylene laterals and of 10 m length were used. Each beginning of lateral has a 16 mm T shaped valve and the end of lateral was closed with an end cap.
4. PVC pipe 2.54 cm inner diameter as manifold. Laterals were elevated to 15 cm above the floor using concrete bricks to facilitate collecting water samples under emitters
5. An electric pump of 372 Watts (Pedrollo PKm60) was used for delivering water from the tank to the manifold. When choosing the pump, water temperature range was considered to assure that the high-water temperature will not affect the pump performance.
6. DN25 brass relief valve water pressure regulator with 2.54 cm inlet diameter provided with side pressure gauge.
7. Digital thermometer with 20 cm length stainless steel probe at 30 cm depth from the top of the tank was used to monitor and detect water temperature. The thermometer has a temperature reading range of -50 to 300 ^{o}C with 0.1 ^{o}C accuracy and ±1 ^{o}C error.

Table 1. Specifications of the used emitters referring to manufacturers.

Emitter	A	G
Manufacturer name	Arab drip	Euro drip
Classification	Long path	Built-in
Country of made	Jordin	Egypt
Maximum operation Head, m	25	50
Flow rate at 10m head	2.23 l/h	1.5 l/h

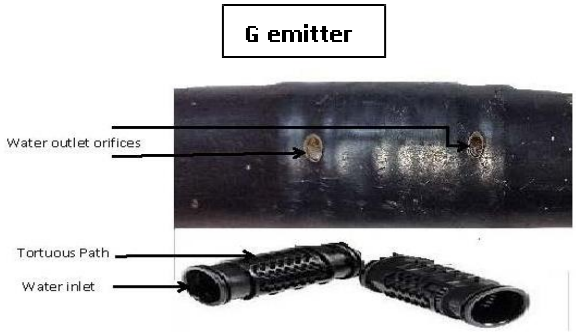

Fig 1. Design and shape of the used emitters A and G

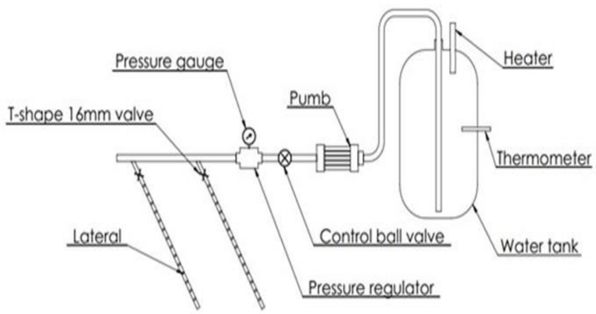

Fig 2. Schematic diagram for experiment irrigation network.

2.1.2 Experiment design

Factors under study included three variables namely water temperature (T) with five levels 20, 25, 30, 35 and 40°C and three operating pressure heads H_1=10, H_2=15 and H_3=20 m of water. and Third variable was emitter type with two emitter types of emitters named A and G. Specifications and design of the used emitters are shown in Table 1 and figure 1.

2.2 Methods

2.2.1 Temperature and operation head control.

Water heating for all required temperature has been achieved basing on the electric heater by adjusting its built-in thermostat to the required temperature value. Through heating process there was a manual move to the water tank to assure temperature homogeneity inside the tank. When the thermometer reading is steady, water pumping for the irrigation network is started. An additive procedure to keep water temperature constant during pumping process using Aluminum foil between tank cap and the body and addition to filling the holes of thermometer and heater with the same material. Operating pressure was adjusted through the pressure regulator basing on its valve to operate the system at the required operating pressure.

2.2.2 Measurements:

2.2.2.1 Uniformity parameters:

Uniformity parameters included flow rate variation (q_{var}), Manufacturing coefficient of variation (CV), emission uniformity (EU), and Uniformity coefficient (UC). Total used samples for emitter flow rate were 24 samples which were selected from each third of laterals. Average of three replicates was calculated and used for uniformity parameters calculations. After pumping water and we assured that all required emitters are working properly without air flushing, a 100 ml can was put under each emitter sample to collect water for 2 minutes. All cans were put under all emitters' outflow orifice at once to assure accuracy of measurement as shown in figure 3. Volumes of water were calculated using graded cylinder with 1 ml accuracy. The resulted flow rate of emitter was determined by dividing total volume over collection time. Average flow rate of the collected samples from each treatment was used to express the flow rate of emitters.

Fig 3. Collecting Water Volume Samples.

2.2.2.2 Flow rate variation (q_{var})

The flow rate variation is usually estimated by comparing maximum and minimum emitter discharges and calculated using the following equation **(Wu and Gitlin, 1975)**: -

$$q_{var} = 100(\frac{q_{max} - q_{min}}{q_{max}}) \text{...........................(1)}$$

Where: -

q_{max}= maximum emitter flow rate l/h.

Manufacturing coefficient of variation (CV)

This parameter indicated the flow rate variation between emitters due to manufacturing and expresses the quality of emitters' manufacturing. When all parameters affecting the flow rate variation is constant, the variation is due to degree of similarity of emitters manufacturing. CV was measure using equations 2, and 3 **(Keller and Karmeli, 1974)**: -

$$CV = \frac{S_q}{q}.100 \text{....................................(2)}$$

$$S_q = \sqrt{\frac{\sum_{i=1}^{n}\left(q_i - q^{-}\right)^2}{n-1}} \text{................................(3)}$$

Where: -

S_q = standard deviation of emitters flow rate.

Evaluation of CV value was as mentioned by **(ASAE, 1996a)**. The evaluation of CV is different from point source emitters like A emitter and line source emitters like G emitter as shown in Table 2.

Table 2. CV values and its corresponding classification

Emitter type	CV range, %	Classification	Abbreviation
Point source	<5	Good	Gd
	5 to <10	Average	Av
	10 to 15	Marginal	Mg
	>15	Unacceptable	Un
Line source	<10	Good	Gd
	10 to 20	Average	Av
	>20	Marginal to unacceptable	Mu

2.2.2.3 Emission Uniformity (EU)

EU describes how uniformly can the drip irrigation system distribute water from each emitter and calculated by the following formula **(Karmeli and keller, 1975)**: -

$$EU = 100\left(1 - \frac{1.27CV}{N_p^{0.5}}\right)\frac{q_{\min}}{q'} \text{..........................(4)}$$

Where: -

EU = design emission uniformity, % q_{min} = minimum observed flow rate, l/h, and N_p = number of emitters per emission point and it was 1 under the experiment conditions.

Evaluation of EU was referring to criteria of **(ASAE, 1996b)**. The evaluation of EU was as follows: - EU ≥ 90% is excellent (Ex), 80 to < 90% good (Gd), 70 to < 80% fair (Fr), and < 70% Poor (Pr).

2.2.2.4 Uniformity coefficient (UC)

Uniformity coefficient expresses the degree of flow rate variation between emitters. The UC% was calculated referring to the equation of **(Christiansen, 1942)** as follows: -

$$UC = 1 - \left(\frac{\sum_{i=1}^{i=n} |q_i - q'|}{q'.n}\right) \times 100 \text{..................(5)}$$

Where: -

n = number of observed emitter or cans, q_i = emitter flow rate, l/h, q\` = average of emitters flow rates, l/h.
Evaluation of UC was referring to **(Bralts, 1986)**. The evaluation of UC was as follows: - UC ≥ 90% is excellent (Ex), 80 to <90% very good (Vg), 70 to < 80% fair (Fr), 60 to < 70% Poor (Pr), and < 60% is unacceptable (Un).

3. RESULTS AND DISCUSSION

3.1 Mean flow rate

Mean flow rate was directly proportional to both operation head and water temperature. Increasing water temperature from T_{20} to T_{40} caused an increase of 100.85, 67.55, 96.34% and 100.82, 93.54, and 100.02% of minimum recorded flow rates at H_1, H_2, and H_3 for A emitter and G emitter, respectively (Table 3).

Table 3. Mean flow rate for both emitters at different experiment temperatures and heads.

Head, m	Temperature	Mean flow rate, l/h	
		(A)	**(G)**
10	T_{20}	1.24	1.15
	T_{25}	2.42	1.90
	T_{30}	2.57	2.07
	T_{35}	3.09	2.73
	T_{40}	3.54	3.25
15	T_{20}	2.25	1.86
	T_{25}	2.61	1.91
	T_{30}	3.07	2.40
	T_{35}	3.26	3.08
	T_{40}	3.77	3.60
20	T_{20}	2.46	1.90
	T_{25}	3.63	2.43
	T_{30}	4.51	2.79
	T_{35}	4.58	3.57
	T_{40}	4.83	3.83

The increase of flow rate due to the increase of temperature was in agreement with the results of (**Rodrı´guez-Sinobas et al., 1999).** This increase is considered high if compared to the increase of their study but it may be acceptable when compared to (**Clark et al., 2005)** as they increase water temperature from 21°C to 45°C which caused an increase of 91% for thin-walled emitters. The change in flow rate might be due to elongation and extension of flow paths inside emitters which permits larger amounts of water to pass through them which was clear in the flow rate increase by increasing water with constant pressure head.

3.2 Flow rate variation (q_{var}):

Table 4 shows the values of q_{var} of the different treatments. The least q_{var} was at T_{40} H_1 q_{var} with a value of 26.32% for A emitter's drip line, while T_{20} H_1 recorded the greatest value which was 89.29% for the G emitter's drip line. Behavior of q_{var} values was compatible with the behavior and trend of results of EU, UC, and CV as there was a reverse relationship between q_{var} and inlet water temperature for both emitters that led to decrease the q_{var} values when increasing water temperature as shown in figures 4 and 5. (**Tahir and Ameen, 2019)** used a similar emitter to A emitter and noticed that raising the pressure led to increase the q_{var}, which is in agreement with the current study results. The east q_{var} was at H_{10} and H_{20} for drip lines with emitters A and G, respectively. Increasing inlet water temperature from 20 to 40°C led to decrease q_{var} by 76.06 and 13.11% of maximum obtained value under the two mentioned operation heads for A and G emitters' drip lines, respectively. These results reflect the role inlet water temperature on decreasing the variation between emitters' flow rates which will impact the whole Uniformity parameters of drip irrigation system.

Table 4. Flow rate variation for both emitters' drip lines at experiment temperatures and heads.

Head, m	Temperature	q_{var}, %	
		(A)	(G)
10	T_{20}	46.34	89.29
	T_{25}	43.33	69.77
	T_{30}	41.80	43.28
	T_{35}	39.29	40.74
	T_{40}	26.32	35.8
15	T_{20}	65.00	62.11
	T_{25}	64.44	40.48
	T_{30}	51.25	40.00
	T_{35}	49.47	36.92
	T_{40}	47.37	35.90
20	T_{20}	68.42	38.46
	T_{25}	64.80	36.21
	T_{30}	61.11	35.00
	T_{35}	60.00	34.00
	T_{40}	57.50	34.00

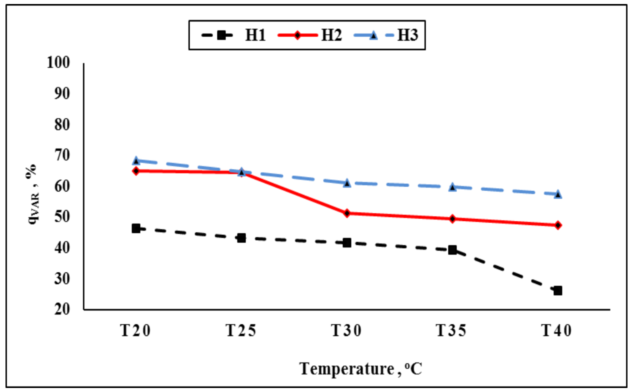

Fig 4. Effect of water temperature and operating pressure on q_{var} for A emitter's drip line.

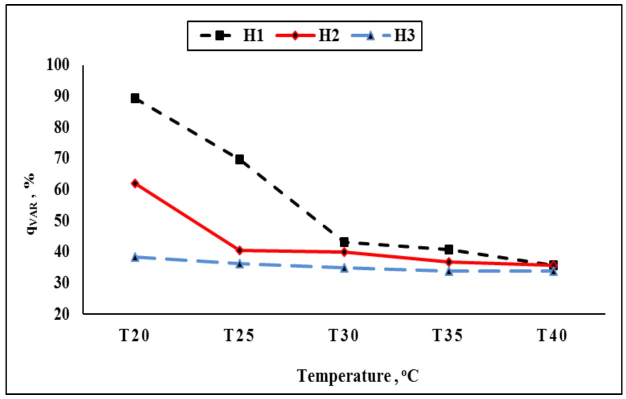

Fig 5. Effect of water temperature and operating pressure on q_{var} for G emitter's drip line.

3.3 Manufacturing coefficient of variation (CV):

According to the results shown in Table 5, $T_{40}H_1$ recorded the least value of CV with a value of 10.14% for the A emitter's drip line, whereas the same emitter at $T_{20}H_3$ recorded the greatest value which was 16.65%. Figures 6 and 7 showed that CV values for the A emitter's drip line decreased with increasing water temperatures and increased with increased operating pressure. For the G emitter, the CV decreased as water temperature and operating pressure increased. The results are in line with those of **(Senyigit and Ilkhan, 2017)** who discovered that increasing water temperatures resulted in decreasing CV values. H_1 with A emitter showed the least CV values, while H_2 and H_3 had nearly identical values except at T_{25} where H_2 showed higher CV value. The G emitter showed higher CV values than A emitter despite all these values were classified as average while they ranged between marginal to unacceptable for A emitter due to their difference in design classification as point source and line source emitters **(Arya et al., 2017).**

Table 5. CV values for both emitters and corresponding classification at experiment temperatures and heads.

Head, m	Temperature	CV, %	
		(A)	(G)
10	T_{20}	11.21 Mg	13.21 Av
	T_{25}	11.13 Mg	12.56 Av
	T_{30}	11.09 Mg	11.00 Av
	T_{35}	10.77 Mg	10.86 Av
	T_{40}	10.14 Mg	10.83 Av
15	T_{20}	16.30 Un	12.87 Av
	T_{25}	15.29 Mg	11.11 Av
	T_{30}	12.65 Mg	10.93 Av
	T_{35}	12.54 Mg	10.78 Av
	T_{40}	11.86 Mg	10.73 Av
20	T_{20}	16.65 Un	10.74 Av
	T_{25}	13.49 Mg	10.67 Av
	T_{30}	12.46 Mg	10.67 Av
	T_{35}	12.45 Mg	10.66 Av
	T_{40}	11.95 Mg	10.62 Av

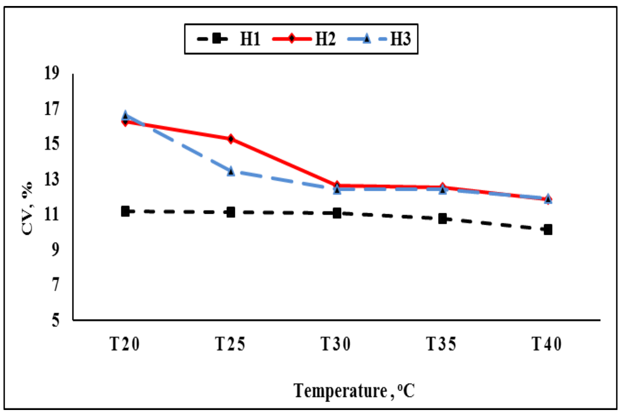

Fig 6. Effect of water temperature on CV for A emitter under different operation heads.

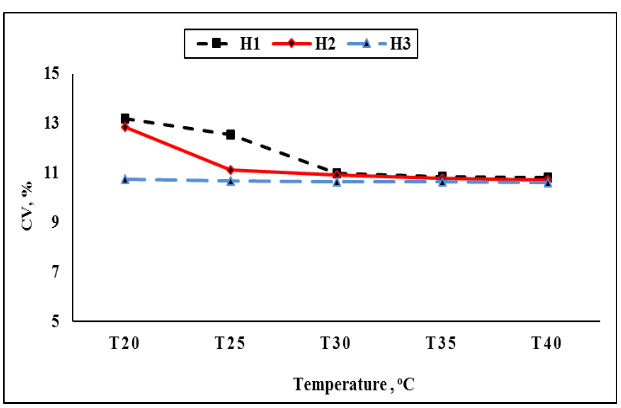

Fig 7. Effect of water temperature on CV for G emitter under different operation heads.

3.4 Emission uniformity (EU):

Increasing water temperature led to increase EU at different operation heads for both emitters' drip lines A and G. Values of EU listed in Table 6 showed that the greatest EU value was 93.75% for A emitter's drip line at T_{40} H_1. The greatest EU for the G emitter's drip line was 80.77% at $T_{40}H_3$. In general, the values of EU for emitter A were greater than the corresponding values for G emitter for all treatments. Treatment $T_{20}H_1$ recorded the least value of 13% using G emitter's drip line. For emitter A, despite the increase in EU values at H_2 by increasing the inlet water temperature, but after reaching T_{30} the EU tended to be lower than the values recorded at H_3 for the same emitter as shown in figure 8.

Table 6. Values of EU and corresponding classification under different water temperatures and heads for both emitters.

Head, m	Temperature	EU, %	
		(A)	(G)
10	T_{20}	78.28 Fr	13.00 Pr
	T_{25}	83.01 Gd	35.54 Pr
	T_{30}	84.00 Gd	67.95 Pr
	T_{35}	86.58 Gd	78.95 Fr
	T_{40}	93.75 Ex	79.73 Fr
15	T_{20}	44.81 Pr	66.50 Pr
	T_{25}	57.90 Pr	74.35 Fr
	T_{30}	60.09 Pr	75.41Fr
	T_{35}	60.67 Pr	76.58 Fr
	T_{40}	63.64 Pr	76.87 Fr
20	T_{20}	42.77 Pr	77.58 Fr
	T_{25}	50.66 Pr	77.90 Fr
	T_{30}	64.76 Pr	79.71 Fr
	T_{35}	67.29 Pr	79.83 Fr
	T_{40}	73.67 Fr	80.77 Gd

For emitter G, the greatest values of EU were at H_3. The values of EU with T_{35} and T_{45} was near to each other's. The effect of water temperature might be clear at H_1 for G emitter, where at T_{35} and T_{40} the EU increased till being near to the maximum obtained values at H_3 which was nearly constant with all temperatures (figure 9). All the values of EU for G emitter's drip line were fair while the only excellent grade for A emitter's drip line was at $T_{40}H_1$. It was noticeable for H_1 that, increasing water temperature from T_{20} to T_{40} led to improve the EU value from fair to excellent. At H_3, EU reached just the good classification for G emitter. Obtained EU values pointed out that each of the two emitters has its most suitable operation head as shown by **(Elamin et al., 2017)** but in general increasing inlet water temperature will lead to increase the EU for drip irrigation system.

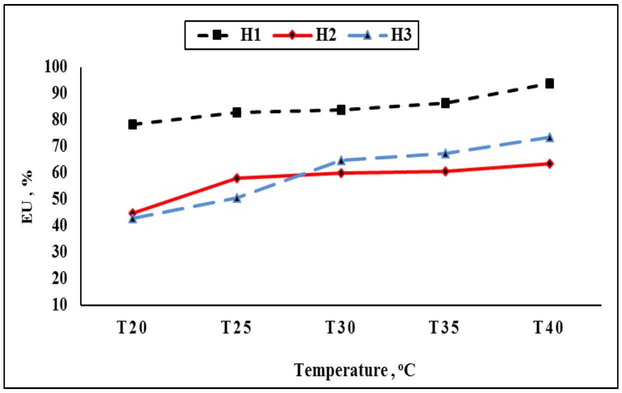

Fig 8. Effect of water temperature and operating pressure on EU for A emitter's drip line.

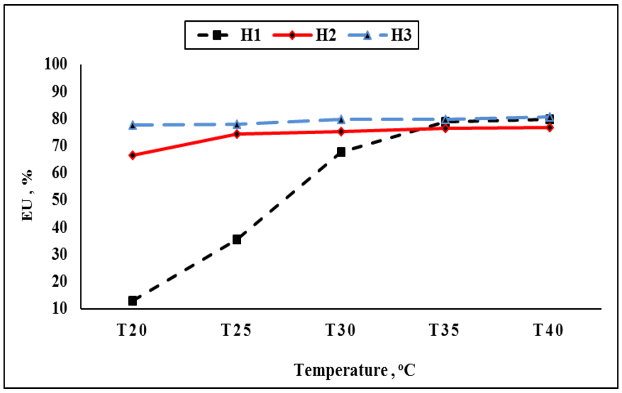

Fig 9. Effect of water temperature and operating pressure on EU for G emitter's drip line.

3.5 Uniformity coefficient (UC):

Results listed in Table 7 showed that T_{40} H_1 recorded the greatest value of UC which was 98.47% for the A emitter, while T_{20} H_1 recorded the least value with 64.46% for the G emitter. Referring to the results, the relationship between Operation head and water temperature was directly proportional for A emitter's drip line, while there was a reverse relationship between operation head and UC for G emitter's drip line with a directly proportional relationship with temperature (figures 10 and 11). UC values for G emitter's drip lines were nearly the same at T_{30}, T_{35}, and T_{40} at all operation heads. This also was the same behavior of EU for the same emitter. **(Kumar and Ashoka, 2020)** mentioned that increasing operating pressure is not necessary to increase UC values of drip irrigation inline emitters which is the same with G emitter in the current study. Effect of inlet water temperature on UC is clear for both emitters as the increase of water temperature from 20 to 40^{o}C led to improve the classification of UC from poor to excellent for G emitter's drip lines at H_1 which showed least UC values for this emitter's drip lines. Also, the same for A emitter's drip lines with the two previously mentioned temperatures, there was an improvement in UC classification from fair to excellent and fair to very good for H_2 and H_3, respectively.

Table 7. Classification and values of UC under different water temperatures and heads for both emitters' drip lines.

Head, m	Temperature	UC, %	
		(A)	(G)
10	T_{20}	92.01 Ex	64.46 Pr
	T_{25}	93.86 Ex	86.75 Pr
	T_{30}	94.20 Ex	90.39 Ex
	T_{35}	95.50 Ex	90.84 Ex
	T_{40}	98.47 Ex	91.81 Ex
15	T_{20}	79.57 Fr	80.69 Vg
	T_{25}	84.37 Vg	89.47 Vg
	T_{30}	88.89 Vg	90.81 Ex
	T_{35}	89.43 Vg	91.10 Ex
	T_{40}	90.45 Ex	91.91 Ex
20	T_{20}	73.83 Fr	91.21 Ex
	T_{25}	79.04 Fr	91.48 Ex
	T_{30}	84.21 Vg	91.65 Ex
	T_{35}	85.20 Vg	91.80 Ex
	T_{40}	88.77 Vg	93.04 Ex

The low values of EU for G emitter's drip lines do not mean it can't be used for drip systems as it can be different in field work especially when using multiple emission points **(Barragan et al., 2006).** According to **(Mirjat et al., 2006)**, UC values of 85% and above is adequate for standard design which means that G emitter can meet the needs of successful drip irrigation operation and may be examined. For H_1 and H_3 which are recommended for A and G emitters, increasing inlet water temperature from 20 to 40^{o}C led to increase UC by 7.00% and 2.00% of minimum obtained UC value for both emitters, respectively.

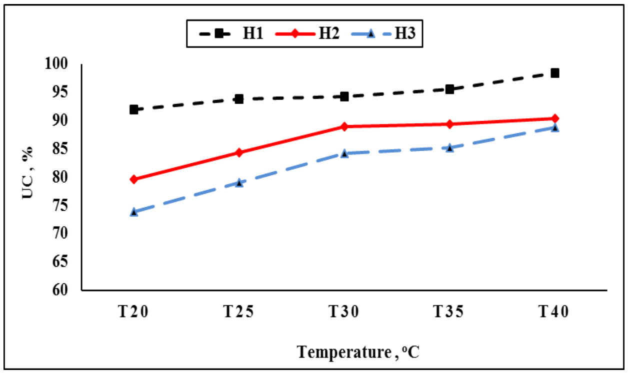

Fig 10. Effect of water temperature and operating pressure on UC for A emitter's drip lines.

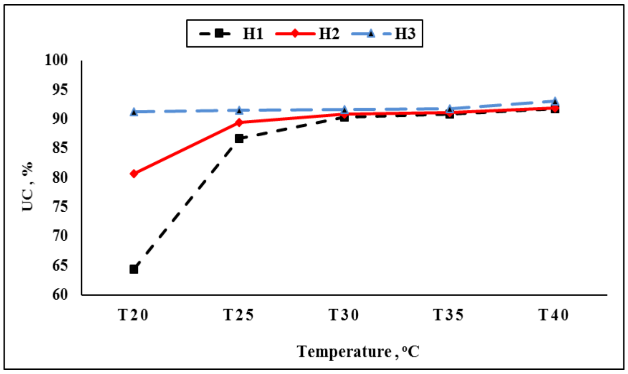

Fig 11. Effect of water temperature and operating pressure on UC for G emitter's drip lines.

4. CONCLUSION

The objective of this study was to follow the effect of inlet water temperature variation on uniformity parameters of drip irrigation system at different pressure heads using two types of emitters A and G drip lines. Inlet water temperature had a noticeable effect on the uniformity parameters of drip irrigation system. Results of this study can be concluded as follows: -

1- Increasing inlet water temperature led to improve the uniformity parameters of drip irrigation system.
2- Drip irrigation system showed a high performance at T_{40} which recorded the greatest values of UC and EU and least values for both CV and q_{var}.
3- The study recommended to use H_3 for G type and H_1 for A type.

Despite recommending high inlet temperature to obtain higher uniformity for drip irrigation system, but these high levels of temperature may have negative effects on plants. The results of this study may be limited to the effect of water temperature on plants which should be deeply investigated.

FUNDING:

This research was self-funded

CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest

AUTHORS CONTRIBUTION:

Elnemr, M. K. developed research proposal, shared manuscript preparation and revision**.**

Abo-Elatta, N. R. A. handled the experiment and measurements and shared manuscript preparation.

5. REFERENCES

Abd El- Baset, M. M.; A. R. Eid; S. A. Wahba; K. F. El-Bagouri and A. G. El-Gindy (2017). Scheduling Irrigation Using Automatic Tensiometers for Pea Crop. Agricultural Engineering International: CIGR Journal, Special issue: 174–183.

Abdelraouf, R. E.; M. A. El-Shawadfy; A. A. Ghoname and R. Ragab (2020). Improving crop production and water productivity using a new field drip irrigation design. Plant Archives, 20(1), 3553-3564.

Acar, B.; R. Topak and M. Direk (2010). Impacts of pressurized irrigation technologies on efficient water resources uses in semi-arid climate of Konya Basin of Turkey. International Journal of Sustainable Water & Environmental Systems, 1(1), 1-4.

Alabas, M. A. A. A. (2013). Evaluation the hydraulic performance of drip irrigation system with multi cases. Global Journal of Researches in Engineering, 13(2), 13-18.

Alizadeh, A. (2010). Principles and practices of trickle irrigation. 2nd edition, university of Mashhad `s Publication.

Arya, C. K.; R. C. Purohit; L. K. Dashora; P. K. Singh and M. Kothari (2017). Performance Evaluation of Drip Irrigation Systems. Int. J. Curr. Microbiol. App. Sci (2017) 6(4): 2287-2292.

ASAE (1996a). American Society of Agricultural Engineers. "Field evaluation of micro irrigation systems". St. Joseph, Michigan. EP405.

ASAE (1996b). American Society of Agricultural Engineers. "Design and installation of micro irrigation systems". St. Joseph, Michigan. EP409.

Aujla, M. S.; H. S. Thind and G. S. Buttar (2007). Fruit yield and water use efficiency of eggplant (Solanum melongema L.) as influenced by different quantities of nitrogen and water applied through drip and furrow irrigation. Scientia. Horticultrae, 112: 142–148.

Barragn, j.; V. Bralts and I. P. Wu (2006). Assessment of emission uniformity for Micro-irrigation design. Biosystems engineering, 9(1): 89-97.

Christiansen, J. E. (1942). Hydraulics of sprinkling systems for irrigation. Trans. Amer. Soc. Civ. Eng. 107:221-239.

Clark, G.A, Lamm, F.R., and Rogers, D.H. (2005). Sensitivity of thin-walled drip tape emitter discharge to water temperature. Applied Engineering in Agriculture, 21(5): 855-863.

Elamin, A. W.; A. M. Abd Eldaiam; N. A. Abdalla; M. E. Hussain (2017). Hydraulic performance of drip irrigation system under different emitter types, and operating pressures using treated wastewater at Khartoum state. International Journal of Development and Sustainability, 6(9), 1086-1095.

El-Habbasha, S. F.; E. M. Okasha; R. E. Abdelraouf and A. S. H. Mohammed (2014). Effect of pressured irrigation systems, deficit irrigation and fertigation rates on yield, quality and water use efficiency of groundnut. International Journal of ChemTech Research, 15(07), 01: 475–487.

El-Nemr, M. K. (2010). Effect of operating pressure variation on uniformity parameters and its impact on crop productivity and power requirements of trickle irrigation. Misr Journal of Agricultural Engineering, 27(4), 1757-1770.

El-Nemr, M. K. (2013). Role of emission uniformity in the sustainable management of drip irrigation system. World Research Journal of Agricultural & Biosystems Engineering, ISSN, 2319-3913.

Hanson, B. and D. May (2007). The effect of drip line placement on yield and quality of drip-irrigated processing tomatoes. Irrigation and Drainage Systems, 21: 109-118.

Hizarjaribi, A., Dehghani, A.A., Helghi, M., and Kiani, A. (2008). Hydraulic performance of different trickle irrigation emitters. Journal of Agronomy, 7(3): 265-271.

Ibragimov, N.; S. R. Evett; Y. Esanbekov; B. S. Kamilov; L. Mirzaev and J. P. A. Lamers (2007). Water use efficiency of irrigated cotton in Uzbekistan under drip and furrow irrigation. Agricultural Water Management, 90: 112–120.

Karmeli, D. and J. Keller (1975). Trickle irrigation design. Rain Bird sprinkler manufacturing crop. Glendora, California, pp133.

Keller, J. and D. Karmeli (1974). Trickle irrigation design parameters. Trans Amer.Soc.Agric.Eng.17 (4):678-684.

Kumar H.P. and H. G. Ashoka (2020). Study on hydraulic performance of drip irrigation system under field condition. Int. J. Curr. Microbiol. App. Sci, 9(2):626-633.

Mirjat, M. S.; A. D. Brohi; A. Shah and A. S. Chandio (2006). Performance evaluation and adoption of trickle irrigation in water scare areas. Water Management and Soil Conservation in Semi-Arid Environments. Marrakech, Morocco, May 14-19, 2006 (ISCO 2006).

Omofunmi, O. E.; O. A. Ilesanmi; T. Orisabinone (2019). Performance evaluation of hydraulic parameters of a developed drip irrigation system. Malaysian Journal of Civil Engineering 31:2 (2019) 9–16.

Rodrı´guez-Sinobas, L.; Juana, L.; and Losada, A. (1999). Effects of temperature changes on emitter discharge. Journal of irrigation and drainage engineering, 125(2): 64-73.

Senyigit, U., and M. S. Ilkhan (2017). The effects of water temperature on discharge and uniformity parameters of emitters with different discharges, types and distances. Journal of Agricultural Sciences, 23(2), 223-233.

Solomon, K. and J. C. Bezdek (1979). Simulated flow requirements for flushing emitters, Trans. ASAE 22(3): 564-568.

Tahir, H. T., and N. H. Ameen (2019). A Comparative study of two types of emitters and two levels of irrigation water pressure and their effect on two varieties of pepper under drip irrigation system. Plant Archives (09725210), 19(2).

Wu, I. P. and H. M. Gitlin (1975). Energy gradient line for drip irrigation laterals. J. Irrig. and Drain. Div., Amer.Soc. Civil Eng.101(IR4):321-326.

تأثير درجة حرارة المياه الداخلة على انتظامية نظام الري بالتنقيط

معتز كمال متولي النمر[1] ونورهان رمضان أحمد أبوالعطا[2]
[1]أستاذ، قسم هندسة النظم الزراعية والحيوية، كلية الزراعة، جامعة دمياط، مدينة دمياط الجديدة، محافظة دمياط. مصر.
[2] باحث مسجل لدرجة الماجستير، قسم هندسة النظم الزراعية والحيوية، كلية الزراعة، جامعة دمياط، مدينة دمياط الجديدة، محافظة دمياط. مصر.

الملخص العربي

أجريت تجربة معملية بقرية أم الرضا، مركز كفر البطيخ، محافظة دمياط، في الفترة من أغسطس الي سبتمبر للعام 2021 على خطوط لنظام الري بالتنقيط بطول 10م وقطر داخلي 16 مم. وكانت أهداف الدراسة كما يلي: 1- دراسة تأثير درجة حرارة الماء الداخل على مؤشرات انتظامية الري بالتنقيط، 2- متابعة التغير في مؤشرات الانتظامية ومدى تأثرها بكل من ضاغط التشغيل ونوع النقاط. شملت الدراسة تشغيل نظام الري بالتنقيط بثلاث ضواغط تشغيل هي 10 ،15 ،20 م من الماء مع خمس درجات حرارة للمياه 20، 25، 30، 35، 40 درجة مئوية ونوعين من المنقطات Aو G لكل خط تنقيط. تضمنت مؤشرات الانتظامية تحت الدراسة كل من المعاملات التالية: معامل الانتظامية UC، معامل اختلاف التصنيع CV، انتظامية التنقيط EU، بالإضافة لمعامل اختلاف التصرف q_{var}. أظهرت النتائج وجود علاقة طردية بين كل من درجة الحرارة وضاغط التشغيل على متوسط التصرف لكلا النوعين. تم الحصول علي اعلي قيم انتظامية تنقيط عند النوع A بدرجة حرارة ماء 40 درجة مئوية وضغط تشغيل 10 م اما بالنسبة لنوع G كانت عند ضغط تشغيل 20 م عند نفس درجة حرارة الماء. لوحظ وجود علاقة طردية بين انتظامية التنقيط ودرجات حرارة المياه حيث عند زيادة درجات الحرارة تزداد الانتظامية للمنقطات على طول خط التنقيط. بشكل عام كان تأثير درجة حرارة الماء الداخل على معادلات الانتظامية ملحوظا، وكان معدل التغير تصاعديا مما يشير الي ان زيادة درجة حرارة مياه الري أثرت بشكل إيجابي على توزيع المياه. مما يستدعي التوصية بدراسة تأثيرات استخدام هذا المدى من درجات حرارة الماء على النبات عند اجراء الدراسات الحقلية.