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EFFECT OF FERTIGATION TECHNIQUE ON SOME ONION PHYSICAL PROPERTIES USING DIFFERENT EMITTER TYPES

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ABSTRACT

Onion is the most widely-used flavoring vegetable in the world. And it is an important export crop in Egypt about 17% ≈ 529.631Tg., from total annually production. Scarcity of water resources in Egypt (arid and sigemi-arid regions) threatening food security. As well as, it is a limiting factor in agriculture expansion. So, maximizing irrigation water productivity by right combination of water and nutrients, and the method of fertilizer application through field water management practices (modern irrigation techniques, and fertigation) in irrigated crops, are a pre requisite for higher yields and good quality production. On the other hand it is very important to overcome water shortage and encourage environment preservation, particularly in sandy soils.

Field experiment was conducted during 2016 /2017 season in private farm at Alexandria Cairo desert road, El-Behiara governorate. To study the effect of fertigation technique on some physical onion yield (quantity) i.e., bulb diameter "d_1 and d_2" (cm)., bulb mass "B_m" (g), bulb actual volume "B_v" (cm^3), moisture content "M_C" (%), and bulb yield "B_Y" (Mg fed^{-1})., through three emitters type, i.e., on line OT4 (I_1), built in drip line GR 16 (I_2) and built in drip line antiroots (I_3), to obtain maximum irrigation water productivity, highest fertilizer effective, promoting yield quantity and quality and preservating environment of hyper mismanagement of water and fertilizer.

Generally, results showed that using (I_3) treatment recorded higher values compared with (I_1) and (I_2) treatments. Where, results indicated that, bulb yield "B_Y" (Mg fed^{-1}) values increased about 8.32 and 2.77%., by using (I_3), compared with (I_1), and (I_2). Also, using (I_3) lead to increased irrigation water productivity "IWP" (kg m^{-3}) about 66.1 and 33.2%., compared with using (I_1), and (I_2). In addition, it could be seen that bulb mass "B_m" (g), was increased by 60.77 and 14.39 %, when using (I_3) compared with (I_1) and (I_2).

Keywords: Drip irrigation, Fertigation, Onion bulb properties, Yield, Irrigation water productivity

INTRODUCTION

Due to the scarcity of water resources and agricultural land in Egypt (arid region), that threatening food security, so field water management practices (modern irrigation techniques and fertigation) should be well utilized to improve and increase irrigation water productivity (IWP), and crop yield, particularly in sandy soils. Application of fertilizer though drip irrigation system (fertigation) is an effective way to promote the use of these resources. Drip irrigated and/or fertigated tomatoes increased water use efficiency by 25 and 17% relative to non-irrigated tomatoes for the light and the heavy soils, respectively, drip and fertigation increased P and N use efficiency for both soil types (**Phogat et al 2013).** Subsurface drip irrigation system was found to be more efficient than surface drip irrigation system to obtain maximum yield accompanied by the highest nutrients concentration in zinnia plants and soil fertility after harvest (**Elhindi et al 2015). Shingade et al (2012)** found that fertilization treatments saved 60.68 % of irrigation water and 20 to 40 % nutrients over surface irrigation system. Drip fertigation resulted into 12 to74% increase in the productivity of onion seed as compared to conventional method **(Dingre et al 2012)**. **Hou et al**

(2007) found that N fertigation using a single drip-application produced the highest seed cotton yield compared with five split drip-applications. For N applied at the beginning of the irrigation cycle rather than in more frequent, smaller doses throughout the irrigation cycle. **Ryan et al (2009)** reported that as our concern is fertilizer best management practices, we briefly indicate the relevance of components of such practices. These are based on numerous soil fertility/agronomy/plant nutrition studies as reported in various reviews of N, P, and micronutrients. Right time, right place, right source, right application method, right application rate. In order to sustain the quality and quantity of crop production system, maintaining and improving soil fertility is very important, and this can only be achieved by applying fertilizers either in inorganic or organic form **(Efthimiadou et al 2010). Rabieyan et al (2011)** reported that the effect of bio fertilizer (biosuper) application on water deficit stress was lower than that of complete irrigation. In addition, the combined effect of nitrogen + bio fertilizer application on water deficit stress was higher than that recorded after their separate applications. In general, the application of nitrogen + bio fertilizer under complete irrigation regime increased seed weight, pod weight per plant and 1000-seed weight of chickpea. **Tarkalson and Payero (2008)** suggested that the increased retention of NO_3-N in the root zone under in-season fertigation with subsurface drip irrigation could result in reduced N application rates to achieve maximum yield in subsequent corn crops.

Kurtz et al (2013) showed that fertilizer application is one of the most important factors in onion production because it directly affects growth, development and yields and he also added fertilizer application is one of the most important factors in onion production because it directly affects growth, development and yields. **Kapoor et al (2013)** showed that increase in NPK fertigation level significantly increased number of leaves, relative leaf water content, marketable yield of cauliflower and benefit cost ratio but decrease in fertilizer expense efficiency.

The aim of this work is observe response of some onion physical traits, and irrigation water productivity to fertigation using different distributers.

MATERIALS AND METHODS

Location and soil analysis

The experiment was conducted from December to April 2016- 2017 season, at open field of private farm for vegetables and fruits production, located at Hosen sector at Alexandria Cairo desert road 70th km., from Cairo, El-Behiara governorate. Soil samples from depth of 0:30 cm., were obtained from experimental field and mixed together. Soil analysis was performed at the soil laboratory, Ministry of Agriculture, using international method with NH_4OH and soil textural class as described by **(Piper, 1950)**.Some physical-chemical properties of the experimental soil are presented in **Table (1)**.

Table 1. Some physical-chemical properties of experimental soil

Texture	**"FC"(%)**	**"PWP" (%)**	**"ρ" (g.cm^{-3})**	**pH**	**"EC" (ds.m^{-1})**
Sand	10.7	3.1	1.62	7.65	2.16

Irrigation and fertigation system

Electrical centrifugal pump with 5 hp., power, 2/2 inch inlet / outlet diameter, and 20 m3 h^{-1}., discharge, at 3 bar pressure head rate, was fixed on well of 50 m., depth and water static head of 3 m. Control head located at the water supply source. It consisted of i.g., pressure tank, valves (control, non-return, and air vent vacuum relief), measuring devices (water flow meter, pressure gauge), regulators (pressure and flow regulators), commutative meter, screen filters with 20 m3h^{-1} water capacity, and 150 mesh. fertigation tanks, Main, sub main, manifold and lateral lines, three different emitters "Em"; 1) online emitters OT4 variety"I_1", 2) pelt in emitters GR 16 variety "I_2" and 3) pelt in emitters, anti-roots variety "I_3", with constant discharge rate of 4 l h^{-1}., were used 30 cm., emitter distance, and the discharge calibration indication that actual average discharge was 4 l h^{-1}.

Fertilizers and Plant

Full rates of phosphorus with about 200 kg fed^{-1}., in form of single super phosphate 15.5% P_2O_5., was added and incorporated into the soil as basal doses during soil preparation. Meanwhile, mixing of cattle manure and chemical fertilizer with rate of 30:70 was used before enrooting. Where, cattle manure with rate of 8 $Mg.fed^{-1}$., also incorporated into the soil. **Table (2)**, show chemical analysis of used cattle manure. On the other hand, nitrogen fertilizer with a rate of 70 kg fed^{-1}., in the form of ammonium nitrate (33.5%., N) was divided into two equal parts at 21 and 35 days after enrooting process through fertigation, and pumped through fertigation system.

Onion seedlings (Allium cepa) cv. Giza 20, with uniform size and free from damage, disease and insects, were obtained from private farmer, and enrooted manually on the ridges with 10 cm., in row spacing.

Table 2. Some Chemical analysis of used cattle manure

(g Kg^{-1})							Ammonium-nitrogen	pH (1:5)	C: N Ratio
O.M	N	P	K	Ca	Mg	NO_3-N			
380.7	14.3	2.5	27.5	9.9	10.6	1.748	15.2	8.2	15.5

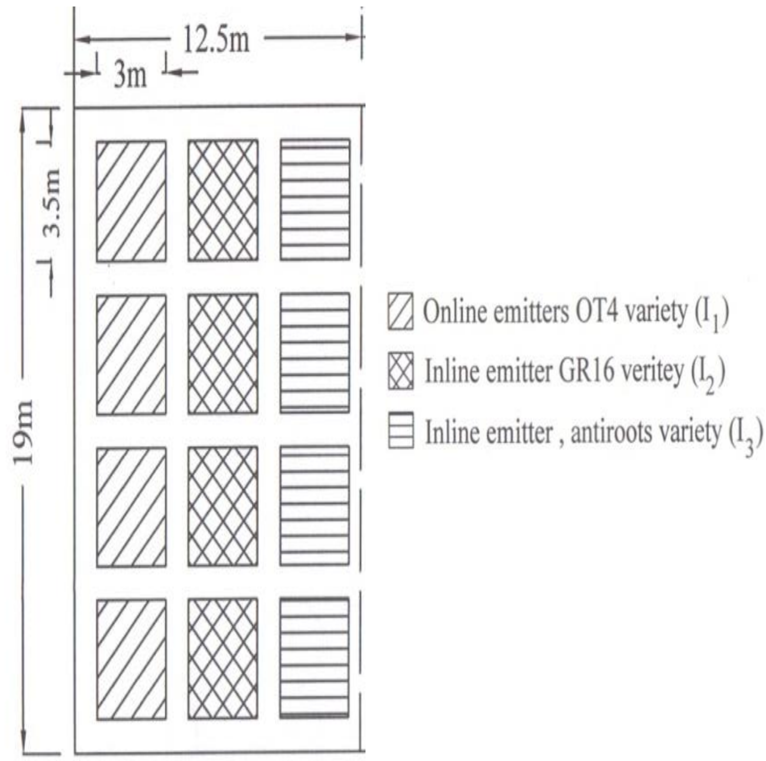

Fig. 1. Experiment layout

Emitters type

Field area 237.5m^2., was divided into 3 main treatments; emitter OT4 "I_1", emitters GR 16 "I_2" and emitters, anti-roots "I_3" with three replicates plots (3.5 × 3m., long and wide ≈ 10.5m^2., i.e. 1/400 fed.) including 6 rows 50 cm wide, each 3.5 m., long, and the distance between sub-plots is left as 1 m., to create a buffer zone **(Fig. 1)**.Total amount of water applied was 25-30 m^3 fed^{-1}.,[according to Central Laboratory for Agricultural Climate (CLAC)].

Studied parameters

At harvest, twenty plants were selected randomly from middle ridge of each plot in such a way that the border effect could be avoided. Bulb top was removed by cutting the pseudo-stem, keeping only was 2.5cm., from the bulb, thereafter, bulb diameter "d_1" and "d_2" (cm), measured at the middle portion of bulb by digital vernier caliber with an accuracy of 0.01 mm. Mass of bulb "B_m" was recorded by digital electrical balance with an accuracy of 0.001g. Bulb actual volume "B_{av}" was determined by liquid displacement method and moisture content "M_C" (%) was determined by electric oven. The total number of plant per plot were counted and recorded, to calculate bulb yield "B_Y" (Mg fed^{-1}) according the following eq.

$$\text{“}B_Y\text{” } = 4.2 \times \frac{\textit{Plant no.per plot} \times \text{“}B_m\text{” } (kg)}{\textit{Net plot area } (m^2)} \ldots.(1)$$

Finally, irrigation water productivity "IWP" (kg m^{-3}) was calculated according to the following eqs.

$$\text{“ IWP”} = \frac{\text{“}B_Y\text{” } (kg\ fed^{-1})}{\textit{Total applied water } \text{TAW}(M^3 fed^{-1})} \ldots\ldots.(2)$$

RESULTS AND DISCUSSION

Results in **Figs. (2 to 7)**, presented some physical properties of onion, and irrigation water productivity as affected by fertigation, through different emitters type ; "OT4" (I_1), "GR 16" (I_2) and antiroots (I_3). It could be realized that bulb diameters (d_1, and d_2) values were increased by about 19.55 and 6.93%., and 20.09 and 6.93%., by using anti roots emitter (I_3), compared with "OT4" (I_1), and "GR 16" (I_2) respectively. Also, using (I_3) lead to increased "B_m" by about 66.1 and 33.2g., compared with using (I_1), and (I_2). On the other hand, "B_V" and "M_C" were decreased by about 39.52 and 16.6 %., and 2.69 and 1.38%., respectively by using (I_1) and (I_2) compared with using (I_3). Finally, It could be realized that bulb yield "B_Y" was increased by 8.32 and 2.77 %, by using (I_3) compared with (I_1) and (I_2). Of these results, "IWP" ,values were increased by 60.77 and 14.39 %., by using (I_3), compared with using (I_1), and (I_2).

The highest value of onion plant parameters was obtained by using "I_3". That, kept the soil moisture near field capacity in the active root zone, throughout the growth period, resulting in low suction which facilitated better plant nutrient and excellent soil-water relationship with higher oxygen concentration in the root zone, this ultimately was reflected on better plant growth under anti roots drip irrigated plants. Also, highest values of d_1, d_2, B_m, B_V, M_C, B_Y, and IWP., this may be due to the performance of antiroots application may be attributed to large uptake of nutrients and effective utilization of these nutrients of increased synthesis of carbohydrates, greater vegetative growth and subsequent partitioning and translocation from leaf (source) to the head. Similar results were obtained **Easmin et al (2009)** in Chinese cabbage.

Maximum diameters and highest onion yield may be due to frequent application of water in the vicinity of the root zone which facilitates better water and nutrient uptake, these results were in harmony with was metabolized **Kashyap et al (2009) and Gupta et al (2010)**. Meanwhile, "I_3" led to nitrogen with synthesizing carbohydrates was motabolised into amino acids and proteins which allowed the plants to grow faster **(Savita et al 2010)**. Using "I_3" not only increased growth rate and production of best quality flower of onion plant but more also enhanced leaf nutrient rates and flower anthocyanin composition, under semi-arid conditions drip fertigation with N fertilizers would aid in easy application and concentration of nutrients suitable to the plant according to it is developmental stage. It reduced salinization and fluctuation in nutrient values in soil during the plant growing season, promoting higher fertilizer use effectiveness and improved plant production.

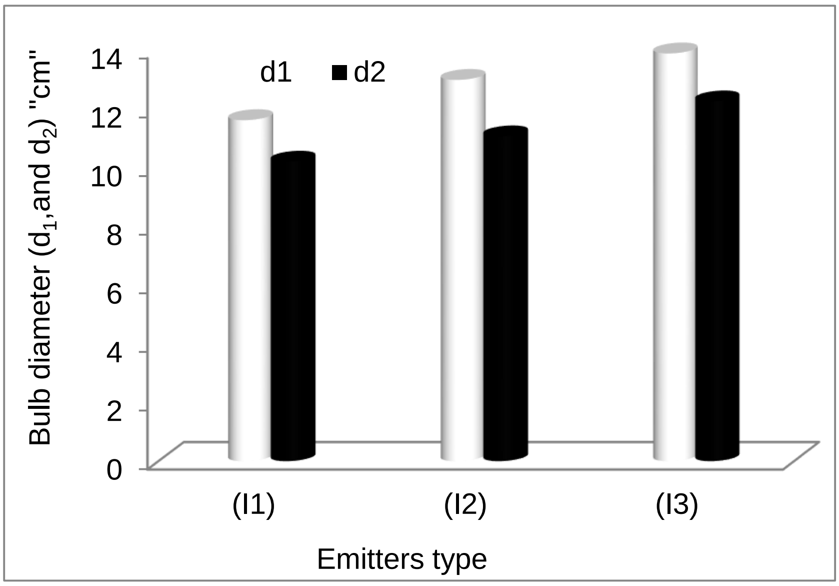

Fig. 2. Fertigation process and it's effect on onion bulb diameters “d_1 and d_2” (cm), using (“I_1”,“I_2”, “I_3”).

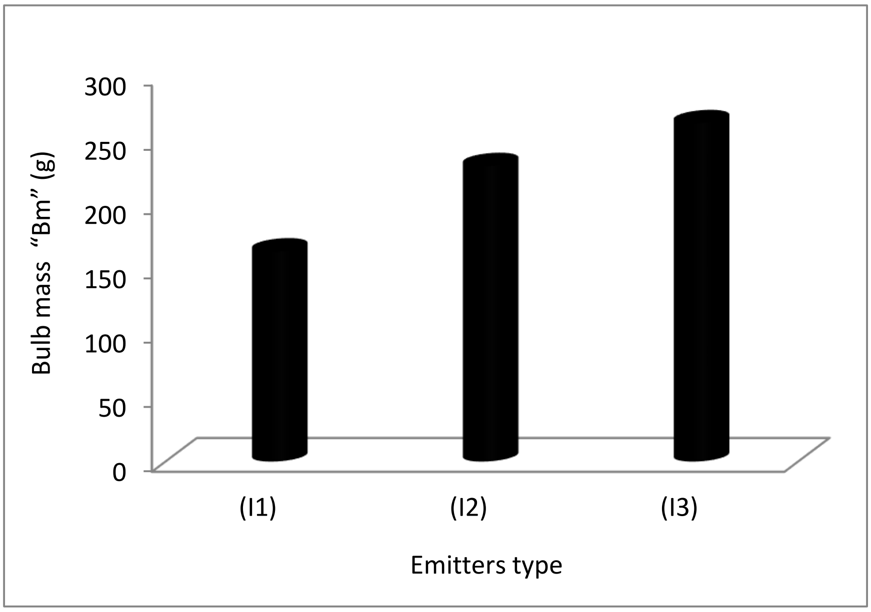

Fig. 3. Fertigation process and it's effect on onion bulb mass “B_m” (g), using (“I_1”,“I_2”, “I_3”).

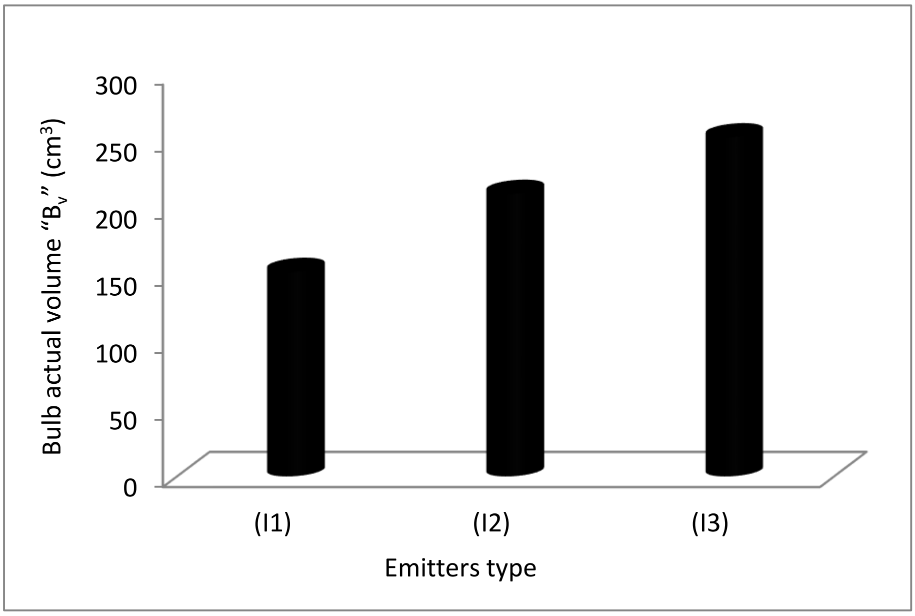

Fig. 4. Fertigation process and it's effect on onion bulb actual volume "B_v" (cm^3), using ("I_1","I_2", "I_3").

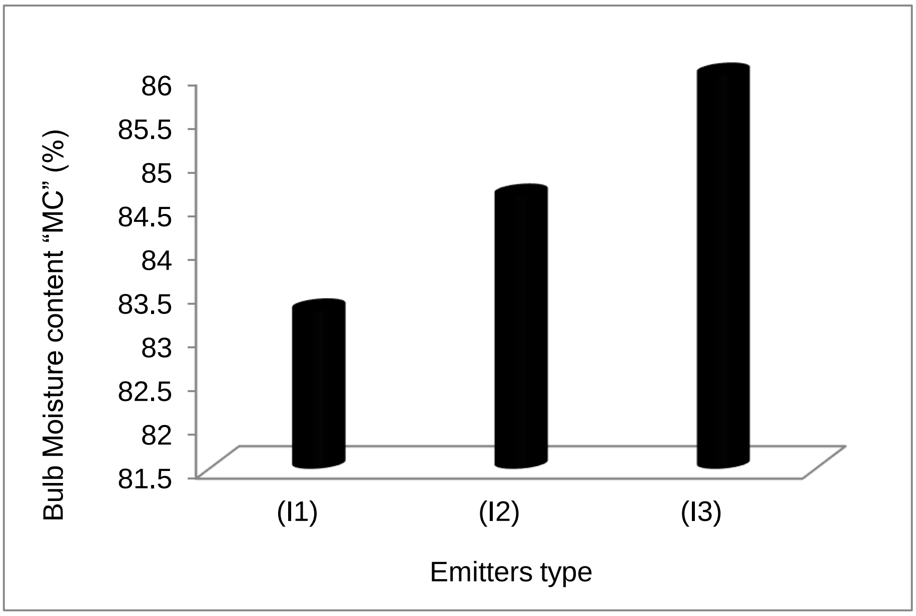

Fig. 5. Fertigation process and it's effect on onion moisture content "M_C" (%), using ("I_1","I_2", "I_3").

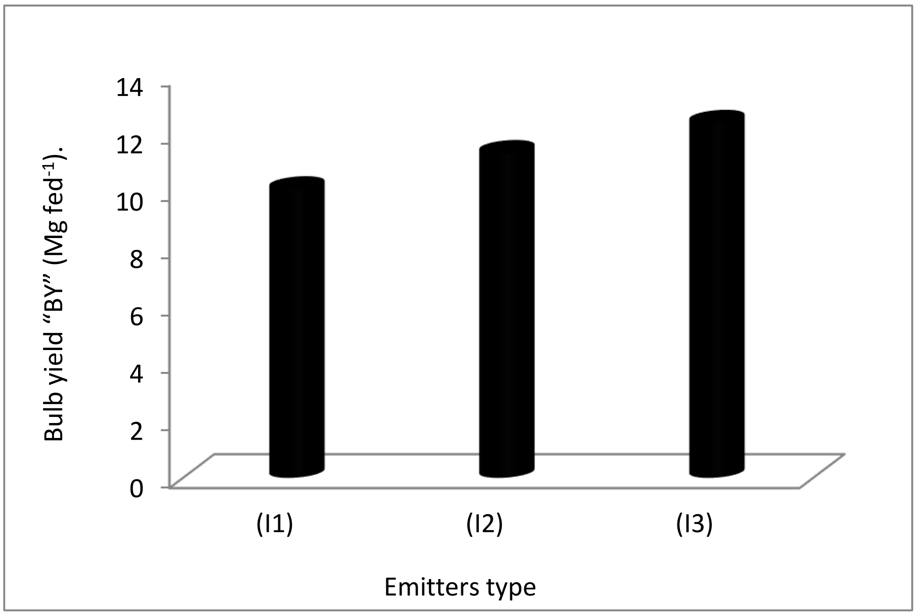

Fig. 6. Fertigation process and it's effect on onion bulb yield “B_Y” (Mg fed^{-1}), using (“I_1”,“I_2”, “I_3”).

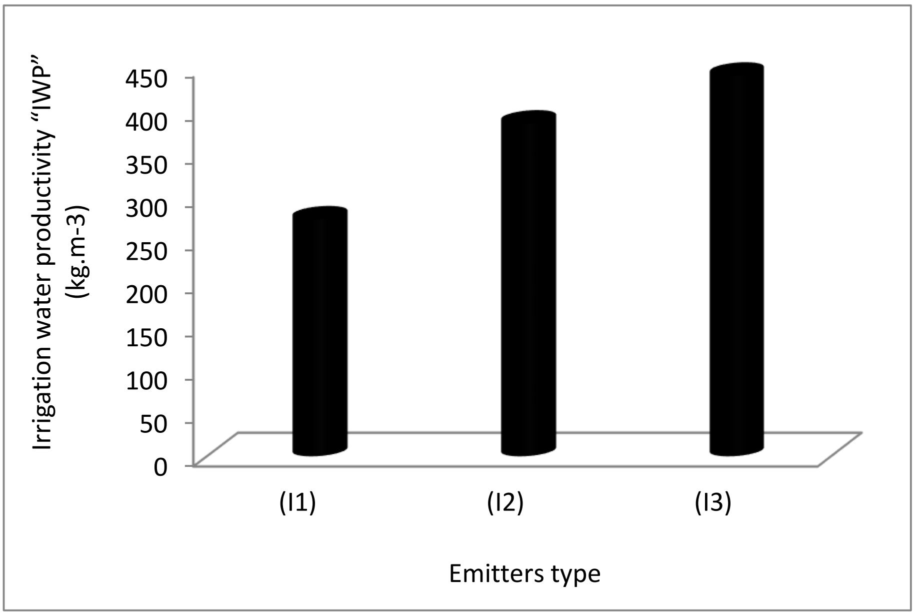

Fig. 7. Fertigation process and it's effect on irrigation water productivity “IWP” (kg m^{-3}), of onion, using (“I_1”, “I_2”, “I_3”).

CONCLUSION

Field experiment were conducted to observe affected some physical properties of onion, and irrigation water productivity by fertigation (mixing of cattle manure and chemical fertilizer), through three different emitters type; “OT4” (I_1), “GR 16” (I_2) and antiroots (I_3). The performance of fertigation with “I_3” were improved bulb parameters, i.e., diameters, mass actual volume, moisture content and irrigation water productivity.

This research recommended that using antiroots (I_3),drip irrigation system with compensation from both mixing of cattle manure and chemical fertilizer (NPK) with rate of 30:70 the highest efficient system to be applicable.

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تأثير تقنيه الري التسميدى على بعض الصفات الطبيعية للبصل بإستخدام أنواع مختلفة من النقاطات

[167]

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الموجــــــز

أجريت هذه التجربة في مزرعة خاصة لانتاج الخضر والفاكهة بقطاع الحسين في الكيلو 70، طريق مصر اسكندرية الصحراوي "محافظة البحيرة" خلال موسم 2017/2016.

وذلك لدراسة تأثير تقنيه الري التسميدى على بعض الصفات الطبيعية للبصل من خلال ثلاث انواع من النقاطات وذلك للوصول الى اعلى كفاءة استخدام الماء والسماد، وزيادة الانتاجية، الحفاظ على جودة المنتج، الحفاظ على البيئة من فرط سوء ادارة استخدام المياه والسماد عن طريق ملاحظة تأثير استخدام نوع التسميد {نثر السماد البلدي مع ضخ عناصر NPK من خلال شبكة الري بنسبه 30 : 70، (F)} مع مقارنة ثلاثة انواع من النقاطات (النوع الأول للنقاط (OT4)"I_1"، النوع الثاني (I_2) "GR 16"، النوع الثالث المقاوم للجذور (I_3) (anti-roots) على بعض الخصائص الفيزيائية لنبات البصل.

ويمكن تلخيص النتائج فيما يلي

أوضحت النتائج أن انتاجية البصل "B_Y" زادت بنسبة 8.32،2.77% في حالة النقاط المقاوم للجذور"I_3" مقارنة "I_1" و "I_2". أوضحت النتائج أن كفاءة ماء الري "IWP" زادت بنسبة 66.1 ،33.2% في حالة النقاط المقاوم للجذور"I_3" مقارنة "I_1" و "I_2". أوضحت النتائج أن كتلة البصل "B_m" زادت بنسبة 60.77 ،14.39% في حالة النقاط المقاوم للجذور"I_3" مقارنة "I_1" و "I_2". أوضحت النتائج أن نوع النقاط المقاوم للجذور"I_3" بصفة عامة أفضل من النوع "I_1"و"I_2" .

الكلمات الدالة: الري بالتنقيط, الري التسميدي, خصائص البصل, الانتاجية, إنتاجية وحدة المياه

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