

**EVALUATION TECHNIQUES OF GARDEN IRRIGATION SYSTEMS ON  
GROWTH FACTORS LANDSCAPING**

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**ABSTRACT**

The current investigation has been conducted during 2010-2012 seasons at three different locations Dokki, Mokattam and 6 October City, Cairo - Egypt in sandy soil, to study the overall impact of evaluation techniques of garden pressurized irrigation systems on growth factors landscaping.

The water was used as irrigation source having EC 0.80 mmhos/cm. The results indicated that:

- 1- By good water management - using pressurized irrigation systems - it can be save about 42% of water under sprinklers irrigation systems comparing with surface irrigation systems this mean that we can increase the area of landscape with 42% area or we can avoiding pollution from saving water which used to irrigate area for landscape by this percentage.
- 2- There was a close relationship between grass consumption, number of cutting and weight of cutting due to the different in sprinkler type (PS-PGP).
- 3- Best water management - for modern irrigation systems - achieves water saving in case of using modern technique of grass spray in compare with traditional methods of irrigation which have highly water loss.

**INTRODUCTION**

Water is an essential factor in agriculture in Egypt. In arid regions where irrigation is required in this case looking for methods to save water by increasing irrigation efficiency. Optimum irrigation scheduling can be based on utilizing grass response to water deficit in order to improve water use efficiency.

Sprinklers irrigation applies less amount of water than surface systems since only a portion of the soil surface area is irrigated. Water use patterns by the crop determines how much water and when to apply, (Amer et al., 2009). Alternative irrigation systems such as sprinkler irrigation, is an advanced irrigation technique for water-saving, irrigation time and water amount (Li and Rao, 2003).

Landscape irrigation will continually grows with increased population and home construction if the demand for the current type of urban landscapes does not change. All plants, including turf grass, require water and nutrients to support growth and maintenance (Connellan, 1999). Cardenas-Lailhacar et al. (2008) found water savings for three commercially available SMS controllers ranging from 69% to 92% without adversely affecting turf quality in Bermuda grass (*Cynodon dactylon* L.) during normal rainfall frequencies. Irrigation of landscapes is necessary to ensure good plant quality due to the sporadic nature of rain events and the low water holding capacity of the soils.

Residential automated irrigation systems use 47% more water on

average than sprinkler systems that are not automated (Mayer et al., 1999). In a companion to the present work, (McCready et al. 2009) reported that, water savings for SMS controllers ranging from 11% to 53% during mostly dry conditions compared with an irrigation schedule based on historical monthly evapotranspiration and rainfall.

Evapotranspiration-based irrigation controllers ideally irrigate according to calculated ET needs of the plant. (Brown et al., 1977) reported that a change from 0.7-cm irrigation applications to 0.9-cm irrigation applications greatly increased the nitrate leaching from ammonium nitrate "NH<sub>4</sub>NO<sub>3</sub>". Surface-applied to a simulated golf green.

Other management factors that affect the ability of turf-grasses to withstand drought include irrigation, plant nutrition or fertilization, aeration and mowing. Increasing mowing height of a turf-grass stand may increase water use rate as a larger leaf area index leads to increased transpiration. As nitrogen fertilization rate increases so does water use by turf-grass due to increased growth stimulated by the fertilizer. Irrigation practices can influence water-use rate, and frequent irrigations increase water use rate because of increased loss of water due to evapotranspiration.

The aim of this research was, to applied water managing by irrigation systems and turf-grass developing. Through this mention several measurements was tested such as (water consumptive use, No. of turf-grass cutting, weight of cutting through constant time and how much water to be saving for add a new land cultivation).

## **MATERIALS AND METHODS**

The experiments designed - Depending hydraulically - according to the Hazen – Williams equation 
$$h_f = \frac{10.67 L Q^{1.85}}{C^{1.85} d^{4.87}}$$
, and were carried out under open field conditions for different tested areas in sandy soil at Dokki (200 m<sup>2</sup>), Mokatm (300 m<sup>2</sup>) and 6 October City (800 m<sup>2</sup>) to investigate the evaluation techniques of irrigation systems factors landscaping. Plan for test apparatus showed in figure (1) and the planning for the three areas design systems showed in figure (2).

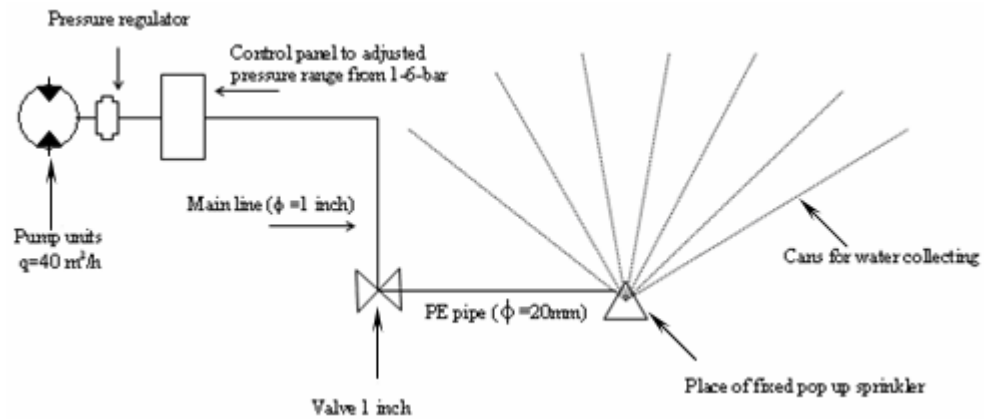
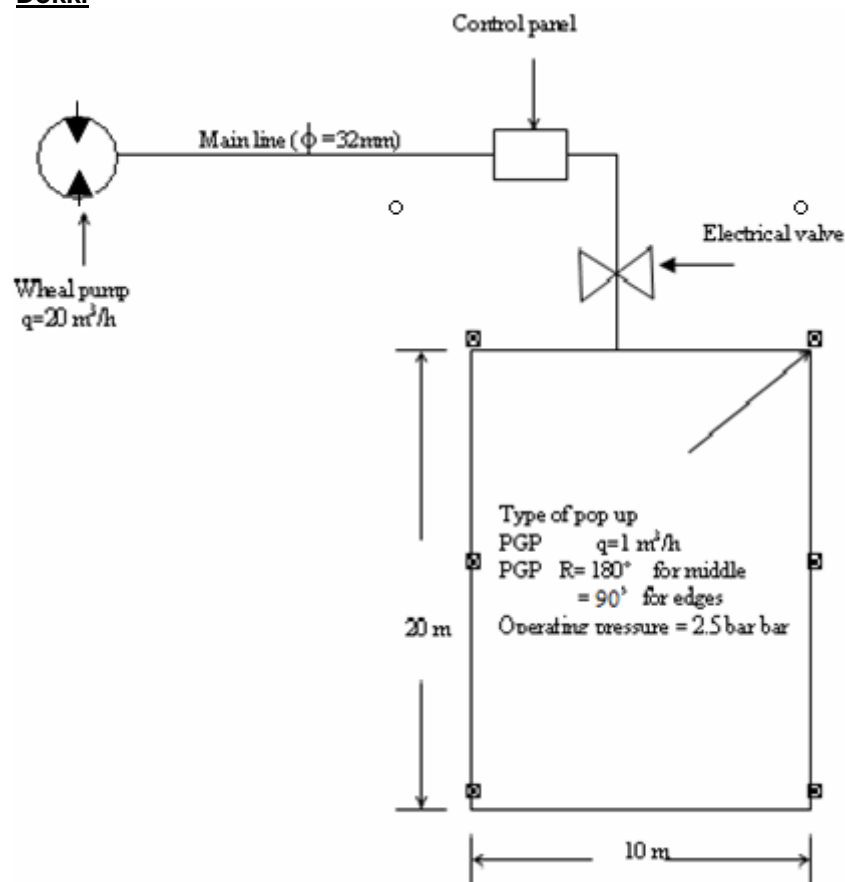
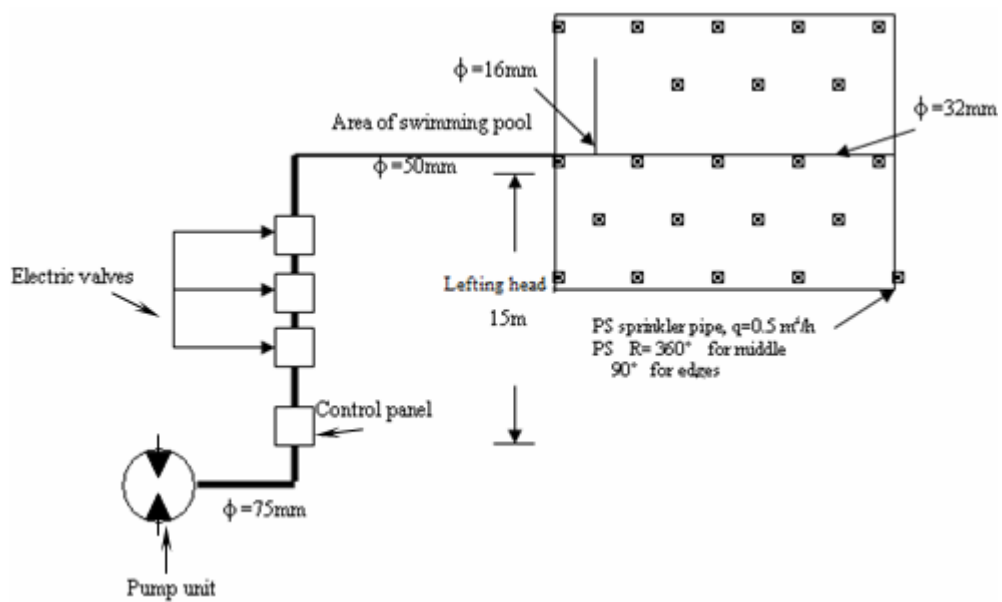


Fig. (1): Plan for test apparatus (Drawing Sketch).

#### A- Dokki



#### B- Mokatm



### C- 6 of October City

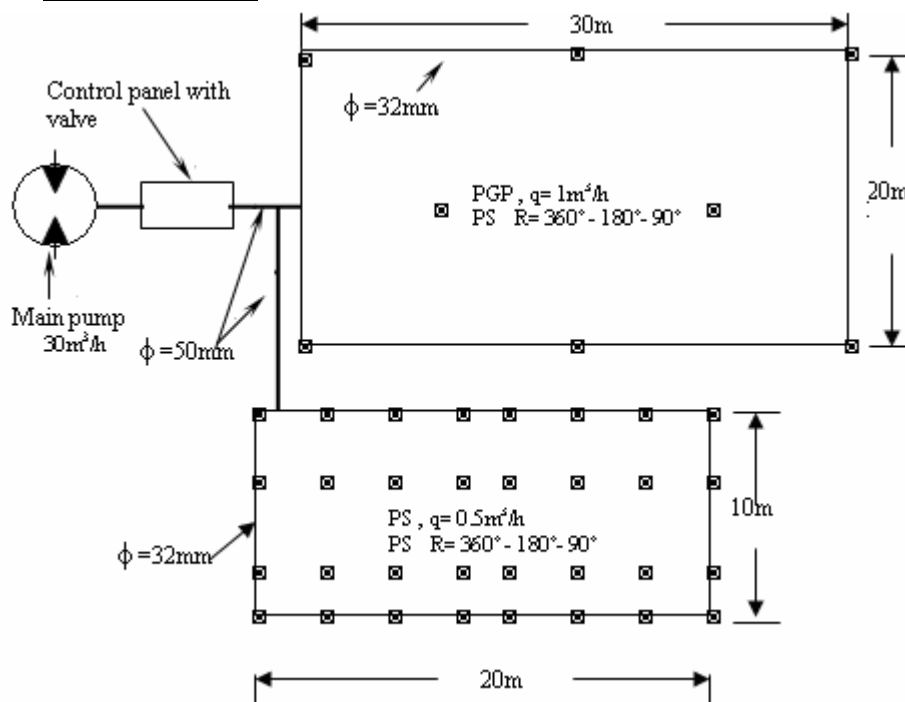


Fig. (2): Plan for the three areas design systems (Drawing Sketch).

Note: As measuring - according to the local market - mineral components of agricultural irrigation network measured with inches and pipes & tubes with mm.

Pop-Up sprinkler irrigation technique was evaluated before the installation to adopt the irrigation times for every place according to weather parameters which already used to manage the water application for every location. This sprinkler was evaluated in Agricultural Engineering Research Institute (AEnRI) at irrigation lab by using the following apparatuses which were been used in this step.

**Measurements methodology was taken as the following procedure:-**

- 1- Calibrate two types of sprinklers (PGP and PS type) which were used in the three locations.
- 2- Schedule the irrigation time according to each area to managing the water applied.
- 3- Comparing the water addition in several items such as water amount ( $\text{l/m}^2/\text{d}$ ) in between the surface irrigation and the sprinkler irrigation for every location under the two type of irrigation systems.
- 4- Calculate the percentage of water saving between the two systems in every location to elements the expecting developing areas in the future.

## **RESULTS AND DISCUSSION**

Data in table (1 and 2) presented in figs (3 and 4) for Dokki area which was been used PGP sprinkler irrigation technique related that, through the year of experiments, it was noticed that the irrigation times increased through the year starting from January stable to March then increasing from April to be straight to June and highest irrigation time was been in July and Aug at the plant peak then decreasing step by step until the winter time.

Data indicated that using specification and system design give the highest productivity from turf grass compared with surface irrigation which was used more than duplicate amount of water as shown in tables (3) by the other main using Pop-Up irrigation technique. Water were used half to half to compare with surface irrigation system also, the extra amount of water was save to use in the other places.

Data in tables (1 and 2) and figs (7 and 8) for sprinkler and surface irrigation showed that, the 6 of October City in the beak time in July and Aug. were been  $11 \text{ l/m}^2/\text{day}$  in the both months compare with surface irrigation systems which were  $18.86 \text{ l/m}^2/\text{day}$  for both months respectively. That main, by saving half water in every place allowed to the response to added may be places of cultivated area or saving water for another using. On the other main, a good water management avoids water less, using swage water and improving environments. Through the experimental time, water management were done according to each area whether parameters.

**Table (1): Water consumption (l/m<sup>2</sup>/d) under sprinkler irrigation system at three locations.**

Months	Mokatm district	Dokki district	6 of October City
Jan.	3.33	0.78	4.67
Feb.	3.12	0.73	4.37
Mar.	3.33	0.78	4.67
Apr.	4.52	3.02	5.81
May	4.67	3.13	6.00
June	4.52	3.02	5.81
July	7.00	4.17	11.00
Aug.	7.00	4.17	11.00
Sep.	4.52	2.02	5.81
Oct.	4.67	2.08	6.00
Nov.	2.26	1.26	2.90
Dec.	2.33	0.65	3.00

**Table (2): Water consumption (l/m<sup>2</sup>/d) under surface irrigation system at three locations.**

Months	Mokatm district	Dokki district	6 of October City
Jan.	5.71	1.34	8.01
Feb.	5.35	1.25	7.49
Mar.	5.71	1.34	8.01
Apr.	7.75	5.18	9.96
May	8.01	5.37	10.29
June	7.75	5.18	9.96
July	12	7.15	18.86
Aug.	12	7.15	18.86
Sep.	7.75	3.46	9.96
Oct.	8.01	3.57	10.29
Nov.	3.87	2.16	4.97
Dec.	3.99	1.11	5.14

The following constant thing was taken as constant elements:-

1- Number of cutting, during the season for five zones (Jan., Feb. and Mar. were the first cutting, Apr., May. and Jun., were the second cutting, July and Aug., were the third cutting. Sep. and Oct., were the fourth cutting and the last cutting was in Nov. and Dec.)

From Fig. (5 and 6) and tables (1 and 2) it was noticed that the three of evaluation parameters which A. number of cutting through season, water consumption, and the weight of cutting grass, were related together. On the other mean, for the last three parameters in Mokatm during Jan., one time cutting per month 3L/ m<sup>2</sup>/d and one kg/m<sup>2</sup> per each time of cutting., this will be approximately through the first time of year (Jan., Feb. and Mar.) regarding to the second period through year (Apr., May. and July) the weight of cutting grass were (0.6 Kg/m<sup>2</sup>). The No. of cutting per month were 4 time and the water consumption (L/m<sup>2</sup>/d) were 4.3 in compare with the third one which almost the highest one for the three parameters resp. 0.8 kg/m<sup>2</sup>, 4 times for grass cutting and 7 L/m<sup>2</sup>/d, then in the fourth and fifth one the three parameters decrease according to whether change in the three area to the warm-call whether.

Fig3,4

fig5,6



Fig7,8

This mean that through the year according to whether change, water management will also change according to plant consumption.

2- From tables (3 and 4) with good water management it can be save about 42% Of water under sprinkler irrigation systems comparing with surface irrigation system this mean that we can increase the area of landscape with 42% area or we can avoiding pollution from swage water which used to irrigate area for landscape.

**Table (3): Water applied ( $l/m^2$ ) under sprinkler irrigation at three locations during season.**

Season	Location		
	Mokatm	DOKKI	6 october city
Winter	266.097	65.596	364.269
Spring	383.484	211.820	504.860
Summer	569.484	349.059	856.194
Outmen	347.892	162.870	447.290
Total	1566.957	789.345	2172.613

**Table (4): Water applied ( $l/m^2$ ) under surface irrigation at three locations during season.**

Season	Location		
	Mokatm	Dokki	6 October city
Winter	455.850	112.200	624.860
Spring	657.820	363.410	866.100
Summer	976.500	598.700	1468.120
Outmen	596.910	279.270	766.890
total	2687.08	1353.58	3725.97

On the other hand, data in tables 3 and 4 showed that water applied at the three locations a clear difference in the amount of water added in each season of the year - by evapotranspiration rates for each area – comparing sprinkler irrigation. And the percentage of saving in irrigation water for the same area as the average for the three tested areas to about 42%.

## CONCLUSOIN

Based on the results of this investigation, the following conclusion could be made:

- 1- Using the sprinkler irrigation system in the open field to irrigate the grass is better than surface irrigation system in view of the saving of water.
- 2- At Mokatam district, the ratio of saving water applied under sprinkler irrigation system compared with surface irrigation system was 41.67% ( $4704 m^3$ ). This amount of irrigated water is enough to irrigate another area equal to  $3001 m^2$  with sprinkler irrigation system.
- 3- At Dokki district, the ratio of saving water applied under sprinkler irrigation system compared with surface irrigation system was 41.68% ( $2369.85 m^3$ ). This amount of irrigated water is enough to irrigate another area equal to  $3002 m^2$  with sprinkler irrigation system.

4- In 6 October City, the ratio of saving water applied under sprinkler irrigation system compared with surface irrigation system was 41.67 % (6521.76 m<sup>3</sup>). This amount of irrigated water is enough to irrigate another area equal to 3001 m<sup>2</sup> with sprinkler irrigation system.

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## تقييم تقنيات نظم ري الحدائق علي عوامل نمو المسطحات الخضراء

وائل سلطان ، مصطفى مصطفى وأمين عواد

معهد بحوث الهندسة الزراعية – مركز البحوث الزراعية – وزارة الزراعة .

- تم إجراء هذا البحث خلال المواسم المتتالية ٢٠١٢-٢٠١٠ بمناطق الدقي بمحافظة الجيزة والمقطم بمحافظة القاهرة ومدينة السادس من أكتوبر ، لتقييم تقنيات نظم ري الحدائق علي عوامل نمو المسطحات الخضراء في التربة الرملية بإستخدام مصدر للري ذو ملوحة ذات متوسط توصيل كهربى " EC = ٨٠ ملليموز/ سم في المواقع الثلاث المذكورة. وأشارت النتائج إلى أن:
- ١ - من خلال إدارة جيدة للمياه يمكن توفير مقدار ما يساوي ٤٢٪ من المياه تحت نظام الري الضغطي الحديث بإستخدام الرشاشات الغاطسة بالمقارنة مع أنظمة الري السطحي التقليدية. وهذا يعني أنه يمكن أن زيادة مساحة المناطق المنزرعة بالمسطحات الخضراء بنسبة ٤٢٪ مما يزيد من تحسن الصفات البيئية للمدن والمجتمعات العمرانية بزيادة المساحة المنزرعة بالمسطحات الخضراء أو توفير هذه النسبة من المياه للإستخدام المنزلي أو الصناعي – حسب صلاحيتها ومصدرها – في تلك المدن والمجتمعات العمرانية.
  - ٢ - أظهرت النتائج أن هناك علاقة وثيقة بين إستهلاك النجيلية بالمسطحات الخضراء وعدد مرات القص ووزنها بنسب مختلفة تبعاً لنوعية الرشاشات المستخدمة (PS-PGP).
  - ٣ - تحسين إدارة نظام الري المستخدم بإستخدام التقنية الحديثة للري الضغطي يحقق توفير في المياه

مقارنة مع الطرق التقليدية في الري.

**بناء على نتائج هذا البحث، يمكن إستنتاج التالي:**

- ١ - تطبيق إستخدام نظم الري الضغطي بالرش في المسطحات الخضراء المفتوحة في المجتمعات العمرانية السكنية والصناعية هو أفضل من نظام الري السطحي ( سواء في الأماكن السكنية الخاصة أو الأماكن والحدائق العامة ) نظرا لتوفير المياه وتقليل الخطر المتوقع والبدهي الناتج عن مشاكل الصرف في المناطق السكنية للمباني والمنشآت ومياه الشرب.
- ٢ - أظهرت النتائج الفرق الواضح في كميات المياه المضافة في كل فصل من فصول السنة - حسب معدلات البخر نتح لكل منطقة - إذا قورن الري بالرش بالري بالغمر.

**ام بتحكيم البحث**

**كلية الزراعة - جامعة المنصورة**

**كلية الزراعة - جامعة القاهرة**

**أ.د / محسن عبد السلام العدل**

**أ.د / عزمى محمود البرعى**