Assessment of Pressurized Irrigation Systems in Hürkuş Public Park at Pursaklar Province of Ankara, Türkiye

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Abstract**—** *In current study, pressurized irrigation systems using for irrigation of landscape plants in Hürkuş park within Pursaklar district of Ankara were researched. In the study technical characteristics of irrigation systems such as in sprinkler systems sprinkler types, sprinkler arrangement, and discharge, and in drip irrigation system, diameters and lengths of main, sub-main and lateral lines, emitter spacing, and emitter discharges were analyzed. In addition, in both irrigation systems, irrigation numbers and irrigation time consequently seasonal applied water were calculated. In result, seasonal applied water by sprinkler and drip irrigation systems were found as around 1382 mm and 1540 mm, respectively. The applied water was mostly relevant to the atmospheric conditions during plant growing cycles as well as plant characteristics*.

Keywords**— *Irrigation, Landscape, Sprinkler Irrigation, System Design, Trickle Irrigation.***

I. INTRODUCTION

In general landscape plants are planted in parks or other nearby buildings for improvement spiritual comfort of people. Those plants serve as facilitating shading areas for people or animals from sunshine burning impacts, wind breaks and so on.

As known that adequate plant growth can be accomplished under no water stress during whole plant growing cycles. Water stress through the rooting systems for mature plants causes slow drops of leaves and declines in plant growth [1]. Successful irrigation water management has reduced environmental risks and improves the water savings. In the literature review, previous studies have focused on irrigation program of turf grasses in general and almost very little about woody plants [2]. In obtaining nice view in parks, timely irrigation is very important role to play particularly in water shortage ecologies such Ankara province of Türkiye. Due to the plenty advantages, pressurized irrigation systems are getting high popularity in most parts of the Türkiye including middle Anatolia region of Türkiye.

Uses of water saving irrigation technologies and doing regular maintenance-repair works for those irrigation system tools are very efficient ways for water economy [3]. It is possible to save water around 30-60% by using drip irrigation technique [4]. Similarly, Manda et al. [5] mentioned about 50% water and 30% fertilizer savings in drip irrigation by comparison to the surface irrigation methods. Water application in drip irrigation technique over surface irrigation systems was almost 30-70%, and production increment was around 20-90% [6]. Water consumption in urban landscape depends on some factors such as designing of landscape, managerial processes, and environmental characteristics. Thus, productive water use in urban residential purpose is also very important in water resources sustainability [7]. In areas where water shortage is serious problem, drought tolerant plants should be planted instead of water sensitive crops. In case of considering high water consuming crops such as grass, wilting or complete drying could be observed due to the insufficient water application and late irrigation during the crop growth cycles [8]. The most important input in landscape areas is watering particularly arid and semi-arid environments. To accomplish well water management, crop patterns should be organized in accordance of current water supplies in such regions [9]. Correct design of the sprinkler irrigation systems leads to high watering uniformity. There are plenty different design types of such systems, and installation costs as well as water application uniformity are affected from system designs [10]. In addition, effects of environmental variables on plant growth should be well understood for successful management of irrigation systems [4]. In irrigation program, having correct information about evapotranspiration (ETc) is vital important. ETc depends on atmospheric conditions such as temperature, relative humidity, wind speed, altitude, and crop characteristics including crop type, growing cycle, root depth, and leaf properties [11].

Limited studies are present in literatures relevant to assessment of irrigation systems using at landscape areas [12]. Therefore, the aim of the present study is to evaluate the drip or sprinkler irrigation systems as a sample Hürkuş public park within Pursaklar town of Türkiye.

II. MATERIAL AND METHOD

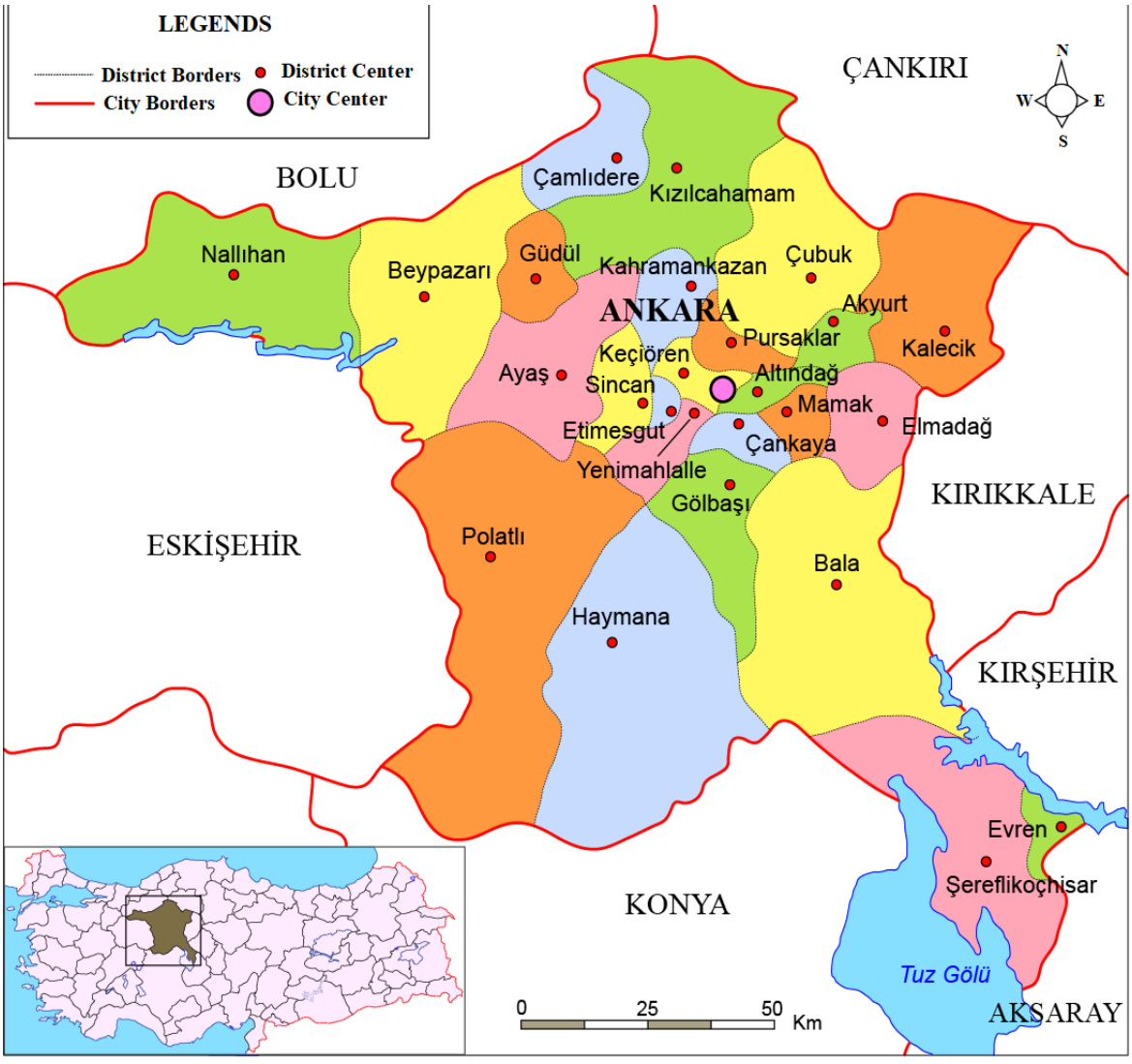
The research was done at Hürkuş Park at Pursaklar town of Ankara, Türkiye (Fig. 1). The town, 950 m above the sea level, is placed on Norhern part of Ankara. The site receives, 416 mm /year, more precipitation than Ankara city center since it is situated on transitional zone of Black Sea region. In general dry environment is prevailing and almost none precipitation has observed at summer period. The rainfall patterns in spring, summer, autumn, and winter are 131 mm, 60 mm, 78 mm, and 167 mm, respectively.

In research, technical properties of pressurized irrigation systems were analyzed. Applied water was determined by using water meter (Fig. 2). In that purpose, seasonal applied water for both sprinkler and drip irrigation systems was calculated as;

$$IW = (Vw/A) \times 1000 \quad (1)$$

Where; IW-Seasonal applied water (mm); Vw-Seasonal applied water (m^3), and A-irrigation area (m^2).

In addition, applicable recommendations were proposed for efficient water management in water shortage Middle Anatolian region of Türkiye.



ANKARA CITY MAP

FIGURE 1: Research site (Pursaklar town)

FIGURE 2: Water meter for measuring water flow

III. RESULTS AND DISCUSSIONS

3.1 Characteristics of irrigation systems

3.1.1 Sprinkler irrigation system

The irrigation water was obtained from tank with a capacity of 10 m^3 (*Figure 3*). The irrigation process was performed by automatically. The diameter of main line was 110 mm. The sprinkler arrangement was (5 x 5) m.

As seen Fig. 3, length of the lateral for each irrigation section was 60 m and there were 12 sprinklers on each lateral. In accordance of site observations, water distribution performance of sprinklers was seen as satisfactory.

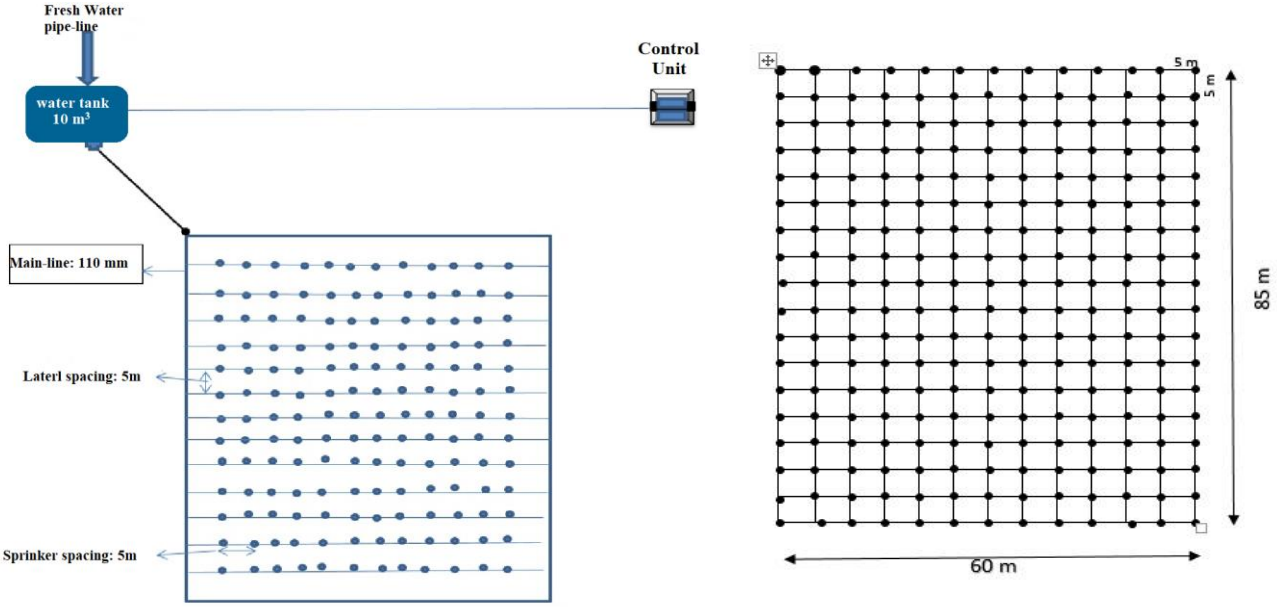


FIGURE 3: Layout of sprinkler irrigation system

3.1.2 Drip irrigation system

Like sprinkler irrigation system, water was taken from tank with a capacity of 10 m^3 in drip irrigation system. The drip system had following components; sub-main line with 63 mm, lateral tubes with 20 mm, 0.80 m lateral spacing and 0.33 m emitter spacing (Fig. 4). In accordance of our measurement, average emitter discharge was found as 3 L/h.

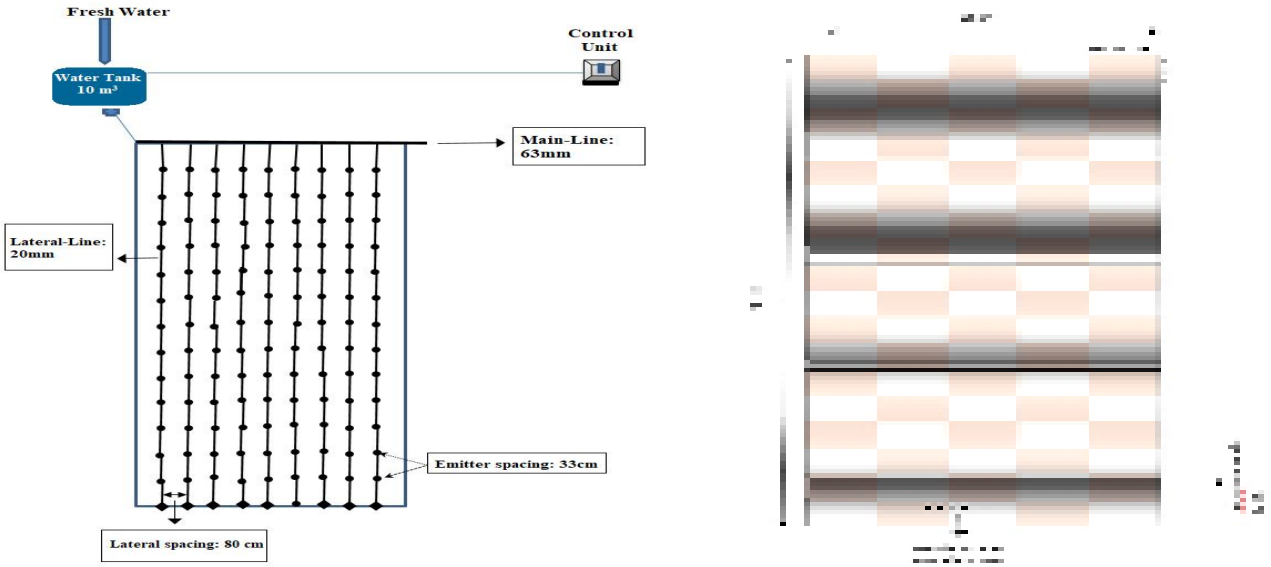


FIGURE 4: Layout of drip irrigation system

3.2 Applied water

3.2.1 Sprinkler irrigation system

Total applied water both the sprinkler and drip irrigation systems were measured as 10516 m³. The applied water by drip irrigation system was 3466 m³ so irrigation water application with sprinkler irrigation system was found as 7040 m³ (10516 m³- 3466 m³).

There were 204 sprinklers in system so sprinkler flow rate was 30.55 m³. Total irrigation time was 135h so sprinkler flow rate was calculated as 0.26 m³/h (30.55 m³/135 h).

Sprinkler precipitation rate (Pr) was calculated as 0.010 m/h (0.26 m³/h / 5x5) or 10 mm/h.

IW can be calculated as 1380 mm/season (7040 m^3/5100 m²).

Total irrigation time was reported as an average of 2-yr 161 h for sprinkler irrigated grass at Utah Botanical Garden with 432 mm precipitation [13]. The finding obtained present study is inline with [13].

The applied water by sprinkler irrigation system to grassland area was around 1380 mm so it is high. Therefore, area-size with dry tolerant plants should be widening for maximizing water productivity in such semi-arid environment. In study [13], the irrigation water for sprinkler-irrigated turf grass for 2009 and 2010 was calculated as about 726 mm, and 837 mm, respectively. This result is none conformity with our findings, and the reason could be differences in environmental conditions, characteristics of plants and management of irrigation systems in both the research sites.

3.2.2 Drip irrigation system

The irrigation time for drip irrigated area during irrigation season was also 135 h. The drip-irrigated area was about 2250 m² and there were 8560 emitters in such area. As mentioned above dripper discharge was found 3 L/h. By using that information, IW was calculated as;

IW = 8560 x 3 L/h x 135 h = 1926000 L = 3466 m³.

IW = (3466 m³ / 2250 m²) x 1000 = 1540 mm/season

The water application duration for different woody plants irrigated by drip irrigation system was mentioned around average 100 h for 2-yr study seasons [13]. The result of current study is lower than [13]. The reasons are possible use of higher drip flow rate, greater than 50 L/h, in Utah research site than our study fields, and differences in environmental conditions for both the research site.

The irrigation water for drip-irrigated woody plants was mentioned as 543 mm, and 628 mm for 2009, and 2010, respectively for Utah conditions [13]. The result obtained current study was greater than [13], and differences can be resulted from irrigation systems, grass types and climates in both the study regions.

IV. SOME RECOMMENDATIONS FOR BETTER WATER SAVINGS

Some parts of the irrigation areas received not enough water possibly due to variations in elevations consequently pressure changes through the pipelines. Therefore, preference of drip laterals with pressure compensation emitters could well solution for high water distribution uniformity across to the field.

In accordance with one study [14], poor water applications in landscape areas can be associated from deficiencies in design and management of the irrigation systems in field level.

In general lateral was found greater than recommended lengths by firms. Thus, laterals should be installed to the lands in accordance with advises by producer company. There was emitter-clogging problem in some emitters. The problem can be solved by use of filters or other technical attempts.

V. CONCLUSION

Proper design of irrigation systems is very important role to play for desired amount of water application for plants. Pressurized irrigation systems are very beneficial for resulting maximal water application efficiency that is vital important particularly poor water ecologies as well as nice growing of plants under proper management. The land-size having drought resistance plants should be widen for reducing water consumption, and to put more areas into the agro-production. Agriculture including landscape activities has used the highest fresh water worldwide so water saving should be started in irrigation at first.

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