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# Effect of Irrigation Water Type on the Growth and Chemical Compositions of Paspalum Grass

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## ABSTRACT

Two field experiments were conducted at Command of the Third Field Army, Agrod, Suez Governorate, , Arab Republic of Egypt, during the two successive seasons of 2016 and 2017, to study the impact of irrigation water type treatments *i.e.*, potable water, reclaimed water, potable water + reclaimed water (at a rate of 50% each) and potable water + untreated wastewater (at a rate of 50% each) the total area of the experiment was 600 $m^2$ on growth and chemical composition of seashore paspalum turf grasses. The results indicated that irrigation water type treatments have significant effects on vegetative growth and chemical constituents in cuts of seashore paspalum turf grasses, in m turf grasses, in the two seasons. The maximum means of these characters are recorded with potable water, followed by seashore paspalum turf grasses irrigated with potable water + reclaimed water (at a rate of 50% each) without significant difference in grass density%, it was found many measurements such as fresh weight, pigment and mineral content obtained the second position, while the lowest values were recorded as a result of irrigation with potable water + untreated wastewater (at a rate of 50% each) in both seasons. Therefore, we recommend using potable water 50% + reclaimed water 50%, as this works to provide half the amount of potable irrigation water.

***Keywords*:** Paspalum, potable water and reclaimed water.

## INTRODUCTION

Seashore paspalum turf grasses (Paspalum vaginatum Swartz) are significant multifunctional turf grasses that are mostly utilized to create green landscapes for private and public gardens. It is also essential for meeting aesthetic and environmental requirements. In particular, the aesthetic impact of parks, gardens, and lawns fulfills the purposes of beautification and their attractiveness is suited for mental health as a key component of the landscape. It is a member of the Poaceae Gramineae family, which also includes the majority of turf grass species.

This plant needs a constant supply of water in order to grow well, and it is preferable to have quality water, which is a problem as we suffer from a lack of water. In addition to that, this plant is of great importance and has a variety of functions, such as linking different design elements together in gardens, parks, sports arenas, airports or Erosion prevention in the landscape of new cities and coastal resorts The majority of these towns are situated in arid regions where water resources may be scarce or irrigation water may be expensive. Plants experience water stress as a result of the water deficit. Water stress has an impact on turf growth and development in a variety of ways, but the most significant impact is on cell division and growth (Mckersi and Leshem, 2013), phytohormones, stomata opening and gas exchange and photosynthesis (Lawlor, 1995).

Water is a requirement and a very important natural resource. Without water, there is no life, as water works to develop societies in the long term, where fresh water must be available and preserved. On the contrary, we find that there is a decrease in water, and it has become noticeable. Demand for water outpaces supply in many nations, and as global population growth and water demands rise, freshwater shortages have developed (Hussain et al., 2019). The main use of fresh water is thought to be irrigation. The majority of freshwater is used for irrigation, which uses about 80% of all freshwater (Hussain et al., 2019). Additionally, it was noted in (Rizzo et al., 2020) they noted that in 2025, nearly 1.8 billion people will reside in areas with a lack of water. Consequently, it is imperative to use other water sources. The treated wastewater can increase Egypt's water resources by up to 5 billion m3. Because wastewater is regarded as an additional inexhaustible, predictable, and now it is clear that the use of wastewater in irrigation has become important and necessary, especially in arid regions, because of its great value (Becerra -Castro et al., 2015 and Johannessen et al., 2015).

The use of treated wastewater from artificial wetlands for irrigation of bermudagrass (Cynodon dactylon (L.) Pers.) turf on the quantitative and qualitative characteristics of the turfgrass as well as on the chemical and physical characteristics of the soil. The findings demonstrate that where freshwater is scarce, treated wastewater offers an extra source of water as well as fertilizers Licata et al., (2016).

Using treated wastewater or other types of treated wastewaters on the production of kikuyu grass (Pennisetum clandestinum). Were studied overall, the recycled water irrigation employing secondary processed wastewater can provide a considerably greater grass yield even in the absence of any kind of fertilizers. Additionally, although it is more expensive, using recycled water for irrigation and using advanced wastewater treatment does not boost yield benefits Shahrivar et al. (2019).

Comparing with conventional irrigation, the use of treated wastewater irrigation in the medium term (a period between the application of treated wastewater irrigation and ten years) increases bermudagrass turf biomass yields without

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affecting the aesthetic value of the plants. This is crucial for maintaining good turf quality, but it might also lead to a number of issues, including more frequent mowing requirements, more biological debris that needs to be disposed of or recycled, and higher labor costs. In contrast, as shown by the results, treated wastewater irrigation reduces the amount of nutrients utilized in commonly used fertilization programs and has positive effects on the cost of mineral fertilizers and environmental contamination. In the medium term, treated wastewater can be a risky source of Na, especially if irrigation is continued for an extended period of time. Therefore, any appropriate agronorganic matter procedures are encouraged in order to prevent any trouble for the soil and plants. We conclude that treated wastewater represents a useful element of sustainable agriculture in the management of open field crops; however, despite the benefits, application must be monitored over the time to prevent any possible damage Licata et al. (2022).

This investigation aimed to study the influence of irrigation water type treatments i.e., potable water, reclaimed water, potable water + reclaimed water and potable water + untreated wastewater on growth and chemical composition of seashore paspalum turf grasses under at Command of the Third Field Army, Agrod, Suez Governorate, Arab Republic of Egypt ecological conditions.

## MATERIALS AND METHODS

Two field experiments were conducted at Command of the Third Field Army, Agrod, Suez Governorate, Arab Republic of Egypt, during the two successive seasons of 2016 and 2017, to study the impact of irrigation water type treatments i.e., potable water, reclaimed water, potable water + reclaimed water (at a rate of 50% each) and potable water + untreated wastewater (at a rate of 50% each) on growth and chemical composition of seashore paspalum turf grasses.

**Water analysis:**

Irrigation water samples were collected to estimate some chemical properties of the used water in agriculture according to APHA (1998) as shown in Table 1.

**Table 1. Some chemical properties of the used water in agriculture during the two seasons of study.**

| Water type / Properties | | Potable water | Reclaimed water | Potable water + Reclaimed water | Potable water + Untreated wastewater |
|---|---|---|---|---|---|
| pH | | 8.19 | 7.64 | 6.76 | 7.07 |
| EC µmhos.cm$^{-1}$ | | 502 | 721 | 780 | 2720 |
| $mg.l^{-1}$ | Ca | 20.35 | 27.05 | 24.09 | 63.84 |
| | Mg | 16.03 | 25.39 | 20.11 | 62.04 |
| | Na | 47.50 | 66.17 | 57.02 | 170.72 |
| | K | 11.79 | 15.79 | 12.58 | 33.46 |
| | $HCO_3$ | 231.22 | 269.34 | 251.44 | 603.68 |
| | $CO_3$ | - | - | - | - |
| | Cl | 49.58 | 68.55 | 58.68 | 155.78 |
| | $SO_4$ | 26.46 | 31.29 | 28.50 | 74.38 |
| | NO3 | 1.64 | 22.03 | 15.34 | 22.65 |
| | NO2 | - | 0.96 | 0.71 | 1.03 |
| | Pb | 0.00028 | 0.058 | 0.0310 | 0.0027 |
| | Cd | 0.000039 | 0.010 | 0.0060 | 0.00056 |
| | Cr | 0.00098 | 0.0019 | 0.00053 | 0.0072 |
| | Al | 0.152 | 0.131 | 0.112 | 0.118 |
| | Mn | 0.00047 | 0.239 | 0.0378 | 0.00177 |

**The experimental design and treatments:**

This experiment was carried out in a randomized complete block design with 3 replicates. Included 4 irrigation water treatments (main plots) as follow:

1- Potable water.

2- Reclaimed water.

3- Potable water + Reclaimed water (at a rate of 50% each).

4- Potable water + Untreated wastewater (at a rate of 50% each).

The total area of the experiment was 600 m$^2$.

**Agricultural practices:**

The experimental field was prepared for experiment through four division and then divided into the experimental units and the method of sprinkler irrigation was used. The amount of irrigation is about 10 liters per day, divided into two times, half an hour in the morning and half an hour in the evening.

Pieces from pre-prepared rolls of seashore paspalum were planted on March 1st for the first and the second seasons, respectively and two cut were taken to estimate the studied characters, the first after three months of planting and the second after four months *i.e.*, in June and July, respectively.

Except as otherwise interfere with experimental treatments and planting area conditions, all agricultural operations of seashore paspalum turf grasses were performed according to the traditional local agriculture management practices in the Arab Republic of Egypt.

**Studied Characters:**

**1- Vegetative growth:**

Samples were taken randomly with dimensions of 60×60 cm$^2$ for each sample from each experimental unit in the two cut and the following parameters were attributed to them:

- Fresh weight.
- Grass density percentage (it was measured once at the beginning of each season by 100 holes in wooden frame (1mX1m)).
- **Photosynthetic pigments content:** Chlorophylls (a+b) and carotenes were estimated by a spectrophotometric method in cuts of seashore paspalum turf grasses after three and four months of planting, as mentioned previously according to Gavrilenko and Zigalova (2003).

**2- Chemical constituents in cuts:**

For determination of macro elements in cuts of seashore paspalum turf grasses after three and four months of planting, as mentioned previously; samples were digested according to (Gotteni, 1982).

- **Nitrogen content (N):** Was estimated according to Jones et al. (1991).
- **Phosphorus (P) and potassium (K) content:** Were estimated according to Peters *et al.* (2003).

**Statistical analysis**

All obtained data were subjected to the statistical analysis according to the technique of analysis of variance (ANOVA) for the randomized complete block design (RCBD) as published by Gomez and Gomez (1984) by using least significant of difference (LSD) method was used to test the differences among treatment means at 5 % level of probability as described by Snedecor and Cochran (1980).

## RESULTS AND DISCUSSION

**Effect of irrigation water type treatments:**

Data presented in Figures 1 to 7 show that irrigation water type treatments have significant effects on vegetative growth *i.e.*, fresh weight, grass density percentage, chlorophylls (a+b) and carotenes content in cuts of seashore paspalum turf grasses after three and four months of planting and chemical constituents in cuts of seashore paspalum turf grasses *i.e.*, nitrogen (N), phosphorus (P) and potassium (K) percentages, in both successive seasons. The maximum means of these characters are recorded as a result of irrigation with potable water, followed by seashore paspalum turf grasses irrigated with potable water + reclaimed water without significant difference in grass density%, while the lowest values were recorded as a result of irrigation with potable water + untreated wastewater in both seasons. On the other hand, the increases in these characteristics of seashore paspalum turf grasses due to irrigation with potable water can be attributed to the fact that it is appropriate to provide clean water around the roots, this water containing very low amounts of salts and heavy elements as shown in Table 1 which caused good conditions for the plants roots to absorb the required adequate water and available mineral elements which affects the final result of the plants. Water moves from the soil to the root hairs by the osmotic mechanism, whereby the osmotic absorption force of the root hairs is higher than the osmotic pressure of the soil and dissolved solution. It is also known that high salinity of irrigation water and its content of heavy elements leads to weak plants and low photosynthesis, in addition to that high salts in irrigation water leads to weak ability of plants to absorb water and thus the amount of mineral elements absorbed, as well as the speed of solution transport within plant tissues. While, the treatment of potable water + reclaimed water contains relatively larger amounts of nutrients and nitrates that the plant needs compared to the treatment of potable water, in addition to its low pH level (6.76) at the same comparison as shown in Table 1, which allows facilitating a huge amount of The elements present in the soil, such as phosphorus and iron, which promote the growth and development of plants. This is in a similar direction to that mentioned before about Licata *et al.* (2016) on bermudagrass, Shahrivar *et al.* (2019) on kikuyu grass and Licata *et al.* (2022) on bermudagrass.

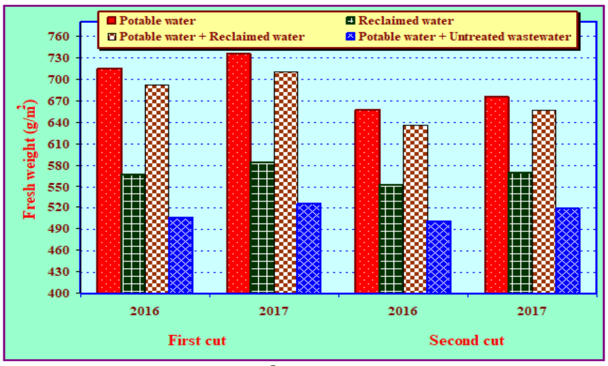


**Fig. 1. Fresh weight (g/m$^2$) in the first and second cuts of turf grasses as affected by irrigation water type during 2016 and 2017 seasons.**

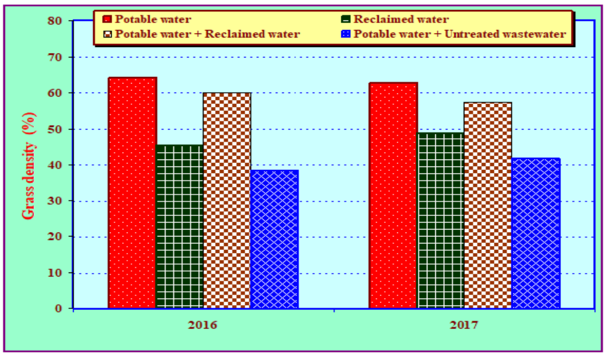


**Fig. 2. Grass density (%) of turf grasses as affected by irrigation water type during 2016 and 2017 seasons.**

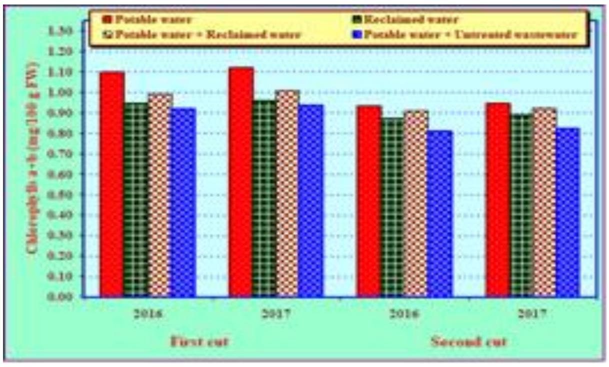


**Fig. 3. Chlorophylls a+b (mg/100 g fresh weight) in the first and second cuts of turf grasses as affected by irrigation water type during 2016 and 2017 seasons.**

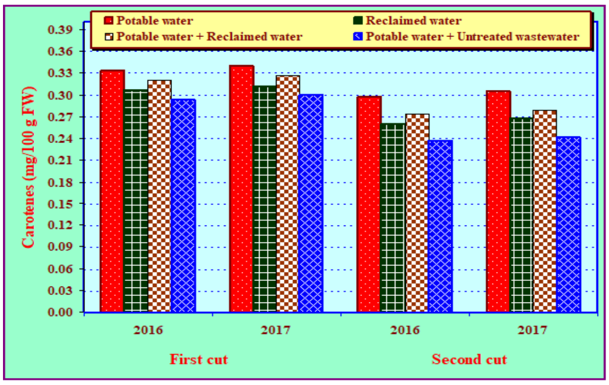


**Fig. 4. Carotenes (mg/100 g fresh weight) in the first and second cuts of turf grasses as affected by irrigation water type during 2016 and 2017 seasons.**

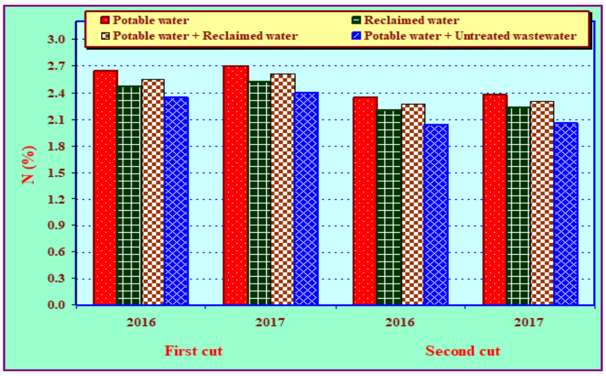


**Fig. 5. Nitrogen (%) in the first and second cuts of turf grasses as affected by irrigation water type during 2016 and 2017 seasons.**

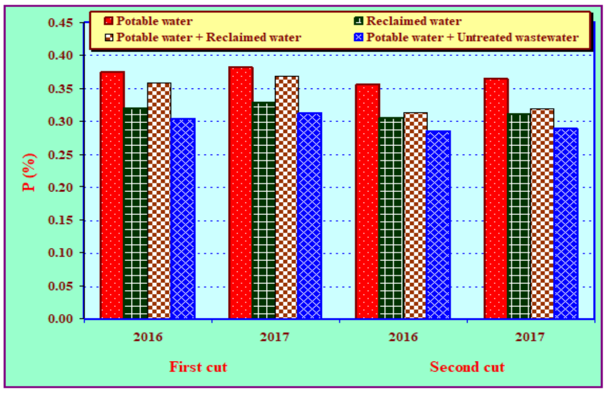


**Fig. 6. Phosphorus (%) in the first and second cuts of turf grasses as affected by irrigation water type during 2016 and 2017 seasons.**

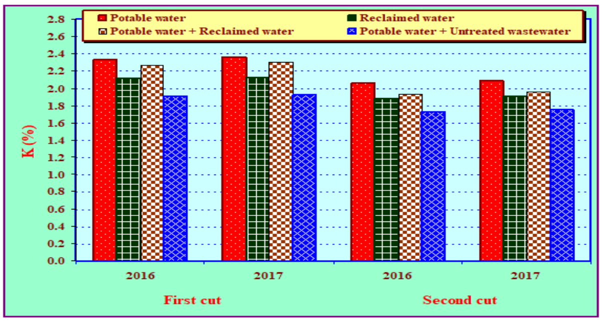


**Fig. 7. Potassium (%) in the first and second cuts of turf grasses as affected by irrigation water type during 2016 and 2017 seasons.**

## CONCLUSION

In view of obtained and discussed results, it was found that irrigated seashore paspalum turf grasses with potable water gave the highest values of vegetative growth and chemical constituents. However it is recommended to use the potable water + reclaimed water(at a rate of 50% each). Although it ranks second in terms of productivity, it saves half the amount of potable water used and contributes to the disposal of wastewater that poses a threat to the environment. It also contributes to reducing the number of times the green surface is mowed, which saves maintenance expenses.

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# تأثير نوعية مياه الري على النمو والتركيب الكيميائي لنجيل الباسبالم

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## الملخص

أجريت تجربتان حقليتان في قيادة الجيش الثالث الميداني –عجرود- محافظة السويس–بجمهورية مصر العربية خلال الموسمين المتتاليين 2016 و 2017 لدراسة تأثير معاملات نوعية مياه الري مثل المياه الصالحة للشرب ومياه الصرف الصحي المعاد تدويرها والمياه الصالحة للشرب + مياه الصرف الصحي المعاد تدويرها بنسبة 50% لكل منهما والمياه الصالحة للشرب + مياه الصرف الصحي غير المعالجة بنسبة 50% لكل منهما و كانت المساحه الكليه للتجربه -600 م 2على النمو والتركيب الكيميائي لنجيل الباسبالم. أظهرت البيانات المتحصل عليها أن معاملات مياه الري لها تأثير معنوي على النمو الخضري والمكونات الكيميائية في الحشات لنجيل الباسبالم في كلا الموسمين المتتاليين. تم تسجيل الحد الأقصى من هذه الصفات نتيجة الري بالمياه الصالحة للشرب ، يليها نجيل الباسبالم المروي بالمياه الصالحة للشرب + مياه الصرف الصحي المعاد تدويرها و لم يكن هناك فرق معنوي بينهما خاصه في النسبة المئوية لكثافه النجيل وقد تم الحصول على العديد من القياسات مثل الوزن الطازج والصبغات والمحتوى المعدني و كانت تحتل المركز الثاني بعد استخدام ماء الصالح للشرب، بينما سجلت أدنى القيم نتيجة الري بالمياه الصالحة للشرب + مياه الصرف الصحي غير المعالجة في كلا الموسمين. و لذلك نوصي باستخدام المياه الصالحة للشرب + مياه الصرف الصحي المعاد تدويرها بنسبة 50% لكل منهما حيث ان ذلك يعمل علي توفير نصف كميه مياه الري الصالحه للشرب