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The Effect of Magnetic Water and Irrigation Intervals on the Amount of the Nutrient Elements in Soil and Aerial Parts of Periwinkle (*Catharanthus roseus* L.)

Davood Hashemabadi[1*], Fatemeh Zaredost [2] and Maryam Jadid Solimandarabi [2]
[1] Department of Horticulture, Rasht Branch, Islamic Azad University, Rasht, Iran
[2] Yanug Researchers and Elite Club, Rasht Branch, Islamic Azad University, Rasht, Iran

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*Corresponding author's email: Davoodhashemabadi@yahoo.com

Abstract

The periwinkle with the scientific name of *Catharanthus roseus* is one of the most important ornamental plants of the Apocynaceae family. In order to evaluate the effect of different waters on the amount of the nutrient elements in soil and aerial parts of *Catharanthus roseus*, a factorial experiment based on completely randomized design was conducted in 3 replications. Experimental treatments were including: type of water (magnetized tap water, tap water, magnetized well water and well water) and irrigation intervals (2, 4, 6 and 8 days). In this study, the attributes such as display life , plant height, leaf number, the amount of nitrogen, phosphorus and potassium of the soil and the plant were evaluated. According to results, the maximum display life (42.23 days), plant height (21.71 cm) and leaf number (165.88) were related to the treatment of irrigation with the magnetized tap water with2 days interval. The maximum amount of nitrogen of the plant was related to the treatment of irrigation with the magnetized well water +2 days interval (0.32 mgl-1). The treatments of irrigation with the non- magnetized tap and well water with 8 days interval had the maximum amount of nitrogen of the soil. The maximum amount of potassium of the plant with 56.21 mgl-1was obtained in the treatment of irrigation with the magnetized well water with 2 days interval. The maximum amount of phosphorus of the plant with 39.5 mgl-1and then 38.8 mgl-1were related to the treatments of irrigation with the magnetized well water + 2 days interval and irrigation with the magnetized tap water+ 2 days interval.

Keywords: Irrigation intervals, Magnetic field, Ornamental plant, Water quality.

INTRODUCTION

Catharanthus roseus is a perennial or annual ornamental plant which normally is cultivated in gardens as an flowering plant. Moreover, this plant is one of the most important pharmaceutical plants of the Apocynaceae family which is containing more than 400 types of terpenoid indole alkaloids such as vinblastine and vincristine (Aslam *et al.*, 2010; Faheem *et al.*, 2011; Kalidass *et al.,* 2010; Loyola-Vargas *et al.*, 2007).

An important point in the production and cultivation of ornamental plants is increasing flowering by using non-chemical methods. Nowadays, researches of agricultural sciences are going towards impact of non-chemical factors like the ionizing, laser and ultraviolet rays, electric or magnetic field on the yeild of different plants (Faqenabi *et al*., 2009; Feizi and Rezvani Moghaddam, 2011).

One of the harmless technologies which is considered in recent years by the researchers of the agricultural science to increase plant yeild and also increase the water productivity through a magnetic field before irrigation (Maheshwari and Grewal, 2009; Lin and Yotvat, 1990; Xiao-Feng and Bo, 2008; Panda *et al*., 2004).

The magnetic water is a type of water that passes through a constant magnetic field. Irrigation water filtration by magnetic field causes positive changes in physical and chemical properties of the water such as pH, electrical conductivity, interfacial tension, solubility of salts and minerals, wetting properties and so causes increasing of the water quality (Xiao-Feng and Bo, 2008; Samadyar *et al.*, 2014). Researchers believe that by passing the water through a magnetic field, the complex structure of the water is converted to a simple structure. The force of interfacial tension of the water is reduced and freedom of action, fluidity and wetting properties of the water molecules are increased. Thus, the magnetic water is absorbed by the plant more easily compared with non-magnetic water and causes increasing of the growth and performance of the plan by increasing and improving nutrient absorption and soluble minerals in the soil and the water (Xiao-Feng and Bo, 2008; Ran *et al.*, 2009).

Ran *et al.* (2009) reported that passing the water through a magnetic field increases the number of water molecules in the volume unit and increases the ability of water molecules to absorb nutrients. These researchers believe that irrigation with the magnetic water increases the absorption of minerals and nutrients by the plants and as a result increases the growth and yeild.

In addition to the water quality, the quantity of water also affects the quantitative and qualitative properties of plants. Tuzel *et al*. (2001) investigated the effect of irrigation periods of 1, 2 and 4 times a day on the bag culture of tomato. The obtained results of these researchers showed that by increasing the irrigation period from 1 to 4 times per day, yeild, number and average weight of the fruits were increased. Fakhraei Lahiji *et al.* (2011) reported that irrigation period of 10 days provides required water of the plant better than 15 days interval and as a result, reduces the soil evaporation and by supplying the required water of the plant, improves the vegetative and reproductive properties of the *Gladiolus'* Rose Supreme'. Saliha (2005) investigated the effect of magnetic water on the physical and chemical properties of the soil and reported the positive effect of magnetic water on the solubility and leaching of the soil's minerals. He said that using the magnetic water is suitable for improving the quality of irrigation water and soil properties for agricultural purposes. In a research, Nashir (2008) evaluated that using the magnetic water has a positive effect on culturing pea and stated that it is because of increasing of the solving power of the magnetic water and absorbing more nutrients from the soil.

Due to the economic importance of ornamental – pharmaceutical plants of *Catharanthus roseus* (Fig. 1a) and also the necessity of using non-chemical methods in the production of the different plants, the purpose of this study is investigating the effect of magnetic water on the growing properties and nutrients elements of the soil and aerial parts of *Catharanthus roseus*.

MATERIALS AND METHODS

In order to investigate the effect of magnetic water treatment and irrigation interval on periwinkle, the factorial experiment was carried out in a randomized complete design with two factors including the type of water (magnetized tap water, tap water, magnetized well water and well water) and irrigation period (2, 4, 6 and 8 days) with three replicates and 16 treatments.

Fig. 1. a: periwinkle; b: water magnetized device of AQUA

Seeds of periwinkle was purchased from Farid Institute of Tehran. Two seeds were planted in transplant pots. The bed used in current study is a mixture of garden soil + leaf composts + sand (1: 1: 1) that its physical and chemical properties has been given in Table 1. 45 days after planting the seeds, seedlings with 4 to 6 leaf were transferred to larger pots.

Irrigating plants was performed from seed planting to a week after transplanting the seedling per day with water corresponding to each treatment. Water magnetized device of AQUA made in Germany was used in order to prepare magnetic (Fig. 1). For this purpose, used water was passed through the machine before the irrigation and was used immediately. Characteristics of used water in has been given in Table 2.

One week after transferring seedling, the effect of irrigating period was applied. Irrigation period was determined using a digital tensiometer. Plant nutrition was performed with complete fertilizer 20-20-20 once every two weeks. In this study, features such as display life, plant height, leaf number, nitrogen, phosphorus and potassium of plant and soil were analyzed. Display life was obtained by counting days from the appearance of the first bud until wilting 50% of flowers of the plant. The number of leaves was measured by counting leaves and plant height in cm at the end of display life. To measure nutrients, the soil was sampled by DTPA and plant was sampled with a mixture of acids (100 ml of sulfuric acid + 6 g of salicylic acid + 18 ml of hydrogen perox-

Table 1. Physicochemical properties of the media used for experimental.

	Available K (mg/kg)	Available P (mg/kg)	Total N (%)	EC (dS m^{-1})	pH
Mixture of garden soil + leaf composts + sand (1: 1: 1)	45.52	24	1.8	0.018	6.69

Table 2. Physicochemical properties of the water used for experimental.

	Na^+ (ppm)	Mg^{2+} (ppm)	Ca^{2+} (ppm)	HCO_3^- (ppm)	Cl^- meq/lit	EC (dS m^{-1})	pH
Magnetized Tap Water (W1)	55.71	48	220	109.8	42.6	0.584	7
Tap Water (W2)	64.28	60	240	125.5	49.7	0.619	7.25
Magnetized Well Water (W3)	53.57	20	220	43.2	78.1	0.647	6.97
Well Water (W4)	62.14	40	230	91.5	95.4	0.656	7

ide) and digestion was performed by heating. Then, nitrogen content of the soil and the plant was measured by Kjeldahl method and titration with sulfuric acid and finally, nitrogen content of the soil and the plant was calculated using the following formula in percent and it was reported:

$$a\text{-}b)\times V/W\times 100/(D.M))\times t\times 0.56=N\%$$

t: The concentration of used acid for titration in mole per liter; a: The volume of consumed acid for sample in milliliter; b: The volume of acid consumed for control the amount in milliliter; V: The volume of extract resulted from digestion in milliliter; W: The weight of the plant to digest in gram; D. M.: The percentage of dry matter.

The amount of phosphorus of plant and soil samples was measured by spectrophotometry method at a wavelength of 470 nm. Finally, the amount of phosphorus was calculated by using standard curve and was reported in mgl^{-1}. Potassium were measured by flame photometery method. In this way the number of potassium of prepared sample was read by flame photometer and then the amount of potassium was calculated using the standard curve in mgl^{-1} and was reported. Data analysis was performed using MSTATC software and comparison of data was performed using LSD test.

RESULTS

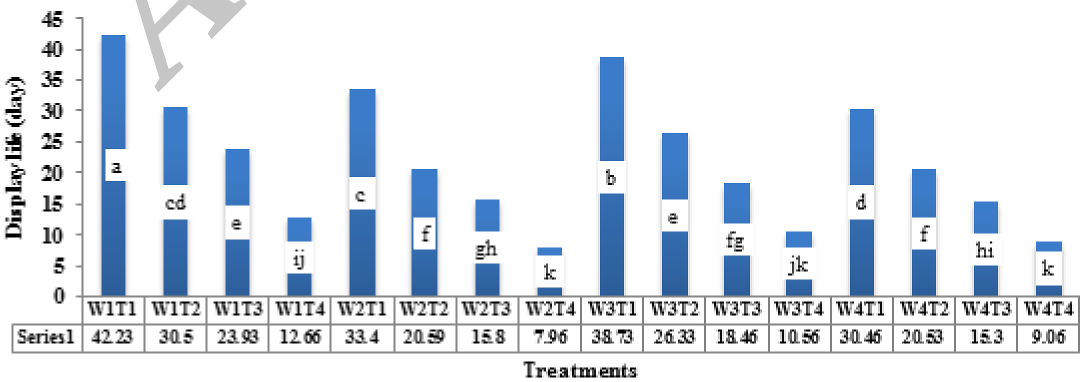
Display life

The interaction effect of different levels of water type and irrigation intervals on display life of periwinkle was significant at 5% level (Table 3). The mean comparison showed that magnetic water had a greater impact on increasing display life compared with the non-magnetic water, as the highest display life with 42.23 days was observed in treatment of irrigation with magnetic tap water 2days interval and then was 38.73 days in treatment of irrigation with magnetic well water for 2 days interval. Minimum display life with7.96 days was related with treatment of irrigation with tap water for 8 days interval that had no significant difference with the treatment of irrigation with tap water for 8 days interval(9.06 days) (Fig.2).

Table 3. Analysis of variance (ANOVA) of the effect of different treatments on traits.

Source of variance	df	Plant pottasium	Soil pottasium	Plant phosphorus	Soil phosphorus	Plant nitrogen	Soil nitrogen	Plant height	Number of leaf	Display life
Water type(W)	3	11.82*	316**	270**	123.25**	0.1155*	0.859**	5.83**	711*	187**
Irrigation intervals(T)	3	111.7**	693**	629**	1647**	0.124*	6.88**	13.84**	3456**	1453**
W*T	9	64.61**	6.74*	133**	39.82**	0.312*	0.338**	1.416*	1297**	8.47*
Error	32	4.00	3.417	4.00	0.964	0.010	0.002	0.483	164.83	3.098
CV (%)	6.05	4.13	6.05	10.27	2.90	48.83	3.63	3.76	10.36	7.90

**: Significant at α= 1%, *: Significant at α= 5%, ns= Not significant



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

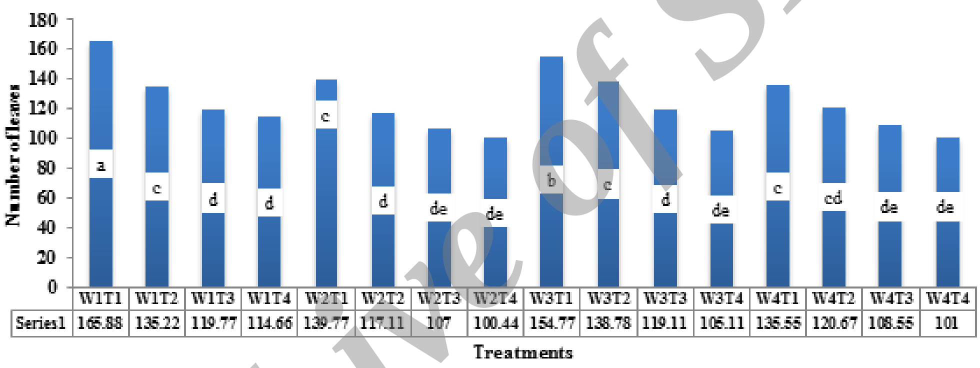
Fig.2. Effect of different treatments on display life of periwinkle.

The number of leaves

The interaction effect of different levels of water type and irrigation intervals on the number of leaves was significant at level of 1% (Table 3). According to the results of comparing the mean of data, the number of leaves was decreased with increasing interval of irrigation period. It should be noted that the applied magnetic treatments on water increased the number of leaves compared with non-magnetic water. As irrigation treatment of magnetic tap water two days interval with 165.9 leaves had the highest number of leaves between the treatments. Irrigation with magnetized well water + two days interval with 154.8leaves had the second place among the top treatments (Fig.3).

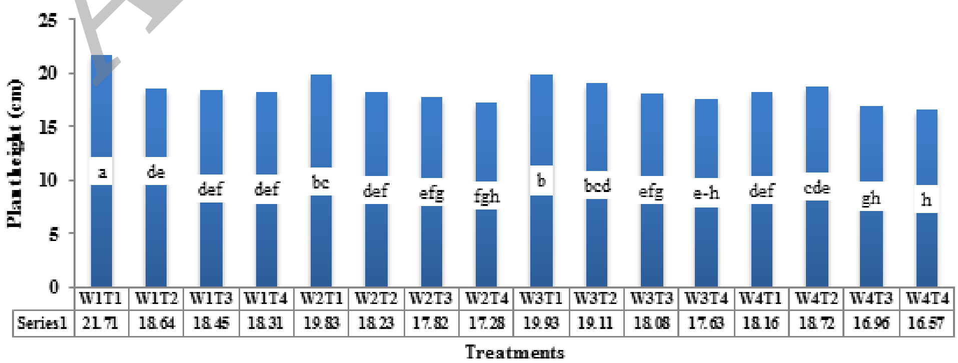
Plant height

A significant difference was observed between various levels of interaction effect of water type and irrigation intervals for plant height at level of 5% (Table 3). The results of the mean comparison of data show that plant height of plants irrigated with magnetized water is higher than of those irrigated with normal water, so that irrigation of magnetized tap water 2 days interval with 21.71cm increases height compared with not irrigation of magnetized well water +2 days interval with 19.93 cm and magnetized tap water (19.83cm) increases height compared with irrigation of not magnetized well water2 days interval (18.16cm). The minimum height of plant was observed for the irrigation of well water + 8 days interval (16.57cm) (Fig.4).



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

Fig.3. Effect of different treatments on the number of leaves of periwinkle.



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

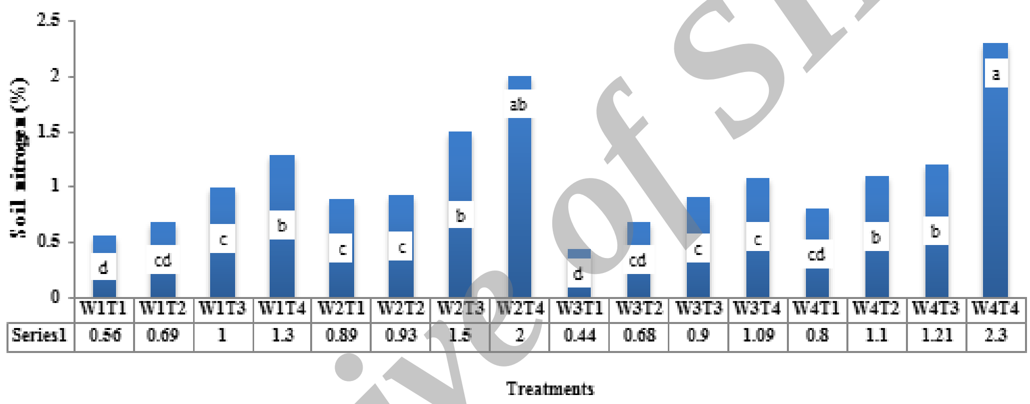
Fig.4. Effect of different treatments on plant height of periwinkle.

Soil nitrogen

The ANOVA showed that the effect of different treatments on the amount of soil nitrogen is statistically significance at 1% level (Table 3).The maximum amount of soil nitrogen is obtained in irrigation of well water 8 days interval (2.3%) and the irrigation of tap water 8 days interval(2%). The minimum amount of soil nitrogen is related with the irrigation treatment of magnetized well water two days interval by 0.44 percent (Fig.5).

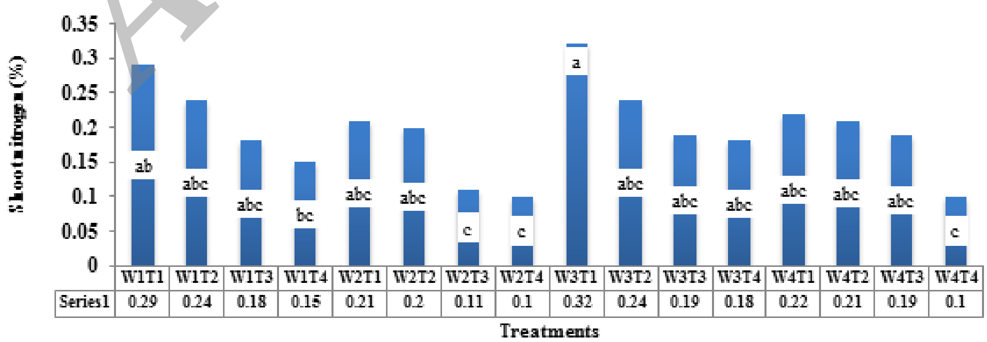
Shoot nitrogen

The effect of different treatments on nitrogen percentage of shoot is significant at 5% level (Table 3). The results of the mean comparison showed that in all treatments as irrigation intervals increased from 2 days to8 days, the amount of nitrogen is gradually decreased. Magnetized wells water 2 days interval with 0.32 % had the maximum percentage of nitrogen and magnetized tap water 2 days interval with 0.29 %had the maximum percentage of shoot nitrogen. The minimum percentage of nitrogen of plant was observed for well water 8 days interval (1.0%) and tap water 8 and 6 days intervals with 0.10 % and 0.11 %, respectively (Fig.6).



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

Fig.5. Effect of different treatments on soil nitrogen of periwinkle.



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

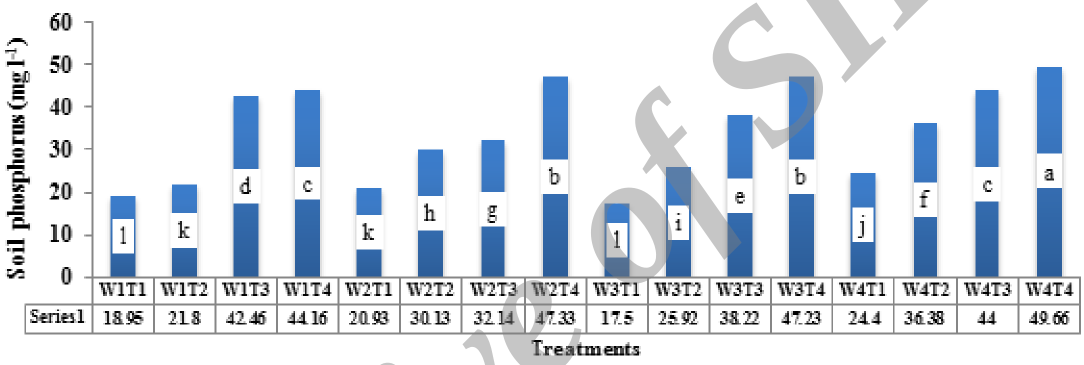
Fig.6. Effect of different treatments on shoot nitrogen of periwinkle.

Soil phosphorus

The effect of different treatments on soil phosphorus was significant at 1 % level (Table 3). The results of mean comparison show that the minimum amount of soil phosphorus (17.50 mgl^{-1}) and then (18.95 mgl^{-1}) belong to irrigation treatments of magnetized well water and magnetized tap water 2 days interval, respectively. Irrigation with well water (49.66 mgl^{-1}), tap water (47.33 mgl^{-1}), and magnetic well water (47.23 mgl^{-1}) 8 days interval had the maximum amount of soil phosphorus (Fig.7).

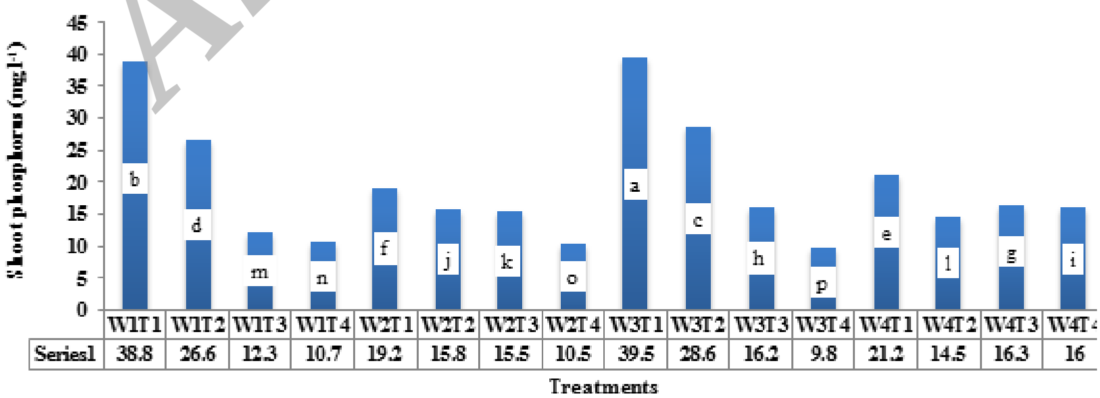
Shoot phosphorus

The effect of different treatments on shoot phosphorus is significant at1% level (Table 3). As seen in Fig. 8,in all treatments as irrigation interval is increased, the amount of phosphorus of shoot is decreased. Irrigation treatments with magnetic well water and magnetic tap water 2 days interval with 39.5and 38.8 mg l^{-1}, respectively had the maximum amount of phosphorus of plant. Irrigation with magnetic well water 8 days interval with 9.8 shoot phosphorus and next, irrigation with tap water and magnetic tap water 8 days interval had the minimum amount of phosphorous of plant that were not significantly different (Fig. 8).



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

Fig.7. Effect of different treatments on soil phosphorus of periwinkle.



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

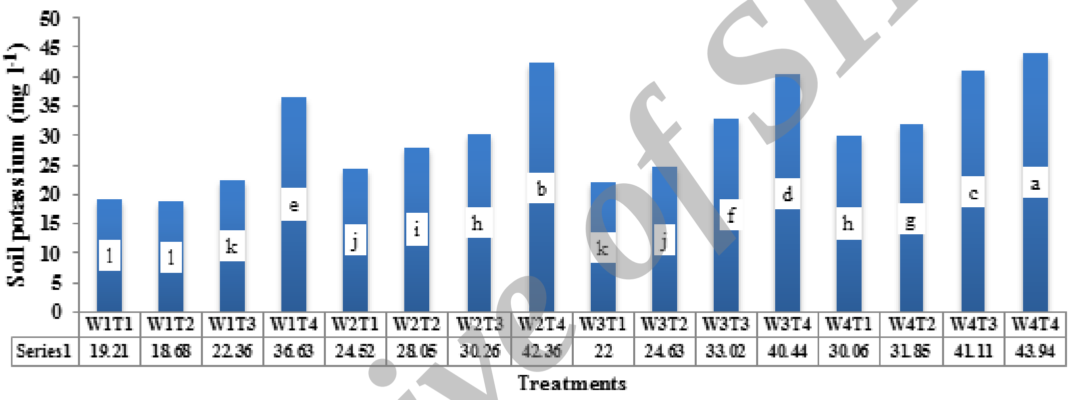
Fig. 8. Effect of different treatments on shoot phosphorus of periwinkle.

Soil potassium

The interaction between type of water and irrigation intervals on soil potassium was significant at 1% level (Table 3). Based on the results of mean comparison obtained from effect of different treatments on soil potassium, using magnetic water for irrigation, especially in lesser irrigation intervals, causes more depletion of the potassium from the soil and the amount of potassium in these treatments is lower than irrigation treatments with large interval periods and normal water. So that the minimum amount of potassium in soil is related with irrigation treatments of magnetized tap water 4 and 2 days intervals with 18.68and 19.21mgl^{-1}, respectively. The maximum amount of potassium in soil is related with irrigation treatments of well water and tap water 8 days interval with 43.94and 42.36 mgl^{-1}, respectively (Fig.9).

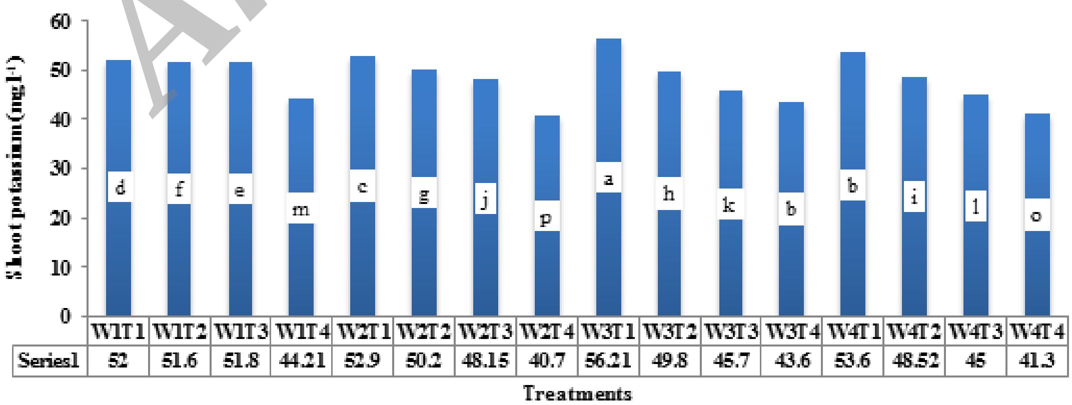
Shoot potassium

The interaction effect between type of water and irrigation interval on soil potassium of plant was significant at 1% level (Table 3). Mean comparison of shoot potassium shows that unlike potassium of soil, potassium content of plants is decreased with decreasing irrigation intervals, so that the minimum amount of potassium of plant is related with irrigation treatment of every 4 types of water 8 days interval



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

Fig.9. Effect of different treatments on soil potassium of periwinkle.



Irrigation intervals	Water type
Irrigation interval 2 days (T1)	Magnetized tap water (W1)
Irrigation interval4 days (T2)	Tap water (W2)
Irrigation interval 6 days (T3)	Magnetized well water (W3)
Irrigation interval8 days (T4)	Magnetized tap water (W4)

Fig.10. Effect of different treatments on shoot potassium of periwinkle.

and tap water 8 days interval with 40.70 mgl^{-1}.Potassium uptake by plants treated with magnetic water with smaller intervals was more so that among the all treatments, irrigation treatment of magnetized well water 2 days interval with 56.21 mg l^{-1} had more potassium compared with other treatments (Fig.10).

DISCUSSION

Shortage and poor quality of water is the most important limiting factor for plant growth. Most of the nutrients in the soil are not absorbed by plants because by irrigation with tap water only a small amount of nutrients is dissolved in water which is absorbable for plants. However, several reports have shown that water magnetic treatment increases the solubility of water.

In fact, with the induction of electric charge on the water, water ions with opposite charge repel each other and are absorbed by magnetic field ions with opposite charge, so the circles of water molecules are increased, thereby its solubility is increased, more nutrients are dissolved in this kind of water and are available for plant, and increases plant growth and yield (Bogatin, 1999; Saliha, 2005; Zangane Youse fabadi *et al*., 2012). As mentioned in the statement of results, magnetic water increases the solubility of soil nitrogen or in other word it increases the discharge of nitrogen from the soil, resulting in its accumulation in the plant. In this respect, the same results are reported by Lin and Yotvat (1990), Maheshwari and Grewal (2009) and Nashir (2008) that shows the use of magnetic water causes the discharge of nutrients (nitrogen, phosphorus, and calcium) from soil and more absorption by the plant, and increased growth and yeild of the plant and these results are in accordance with the results of this study.

Researchers studied the effects of magnetic water on minerals in the soil and concluded that the concentration of nitrogen, potassium, phosphorus and magnesium + calcium in the soil irrigated with magnetic water is different from that in the soil irrigated with conventional water. They stated that magnetic water by accelerating the processes of crystallization and sedimentation of nutrient dissolved in the soil, reduces the movement of the mineral toward down and as a result greater amount of these elements are adsorbed by plants (Noran *et al*., 1996). Maheshwari and Grewal (2009) reported that magnetic water with organic compounds by affecting on organic compounds causes more solubility and accessible of nutrients for plants and thus improves growth and yeild. Ahmadi (2010) believes that by passing water through a magnetic field, absorption of minerals, useful salts and elements in soil and water is increased because of more solubility and freedom of water molecules. Several researchers believe that the accumulation of potassium in the plant by preventing the destruction of cells against active oxygen species, increasing activity of antioxidant enzymes and increasing water use efficiency, causes the maintenance of the cell turgor and improves plant morphological and physiological features (Nandwal *et al*., 1998; Zheng *et al*., 2008; Hu and Schmidhalter, 2005). Grewal and Maheshwari (2011) reported the increase of potassium in pea plants treated with magnetic water.

The use of magnetic water causes the discharge of phosphorus from the soil and more absorption of it by the periwinkle plant. Durate Diaz *et al*. (1997) reported the increase of nutrients in tomatoes by treating the plants with a magnetic field. Lin and Yotvat (1990) stated that magnetic water increases the absorption of phosphorus and calcium of the soil that by plant and increases growth and yield of the plant. The use of magnetic water for irrigation of celery and pea increases the concentration of calcium and phosphorus in the shoot (Maheshwari and Grewal, 2009). Nashir (2008) reports the increase of the solubility of elements in soil and their absorption by the pea plant that is in accordance with our results.

In current study, irrigation with magnetic water compared with non-magnetic water causes to improve the growing traits that this can be attributed to more accessible nutrients for bushes of periwinkle plants irrigated with magnetic water. In addition, irrigation periods had a significant impact on increasing the display life and mentioned traits, so that as the interval of irrigation is increased, the display life and the number of leaves and plant height is decreased that this trend was less in magnetic water compared with non-magnetic water.

Researchers believe that reducing the electrical conductivity of the magnetic field leads to breaking of water structure, and by reducing the surface tension of water causes more freedom and mobility of water molecules, and the solubility of available nutrients for plants is increased. Then, it increases the photosynthesis and food production ability of the plant by increasing the uptake of water and nutrients by the roots of the plant, and these factors increase the vegetative and reproductive growth and yield of the plants (Nashir, 2008; Ran *et al*., 2009; Hozayn and Abdul Qados, 2010; Nikbakht *et al*., 2013). Nashir (2008) found that the magnetic water increases the height of a pea for 2.67 cm compared to the control. He stated that the reason of this fact is the increase of the solving power of magnetic water and provide more water for the plant. Similar results for the lentil are reported by Abdul Qados and Hozayn (2010) that are corresponded with the results of this study. Finally, it can be said that the magnetic water with suitable interval for irrigation, by more and better providing nutrients, provides better conditions for the plant compared with non-magnetic water and causes to maintain and increase the quality and quantity of the periwinkle plant. Therefore, the use of this water for irrigation of periwinkle is recommended.

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تاثیر آب مغناطیسی و دورهای آبیاری روی میزان عناصر غذایی خاک و اندام هوایی پروانش (*Catharanthus roseus*)

داود هاشم آبادی[۱*]، فاطمه زارع دوست[۲] و مریم جدید سلیماندارابی[۲]
[۱] استادیار گروه باغبانی، واحد رشت، دانشگاه آزاد اسلامی، رشت، ایران
[۲] عضو باشگاه پژوهشگران جوان و نخبگان، واحد رشت، دانشگاه آزاد اسلامی رشت، ایران

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* ایمیل نویسنده مسئول: Davoodhashemabadi@yahoo.com

چکیده

پروانش با نام علمی *Catharanthus roseus* یکی از مهمترین گیاهان زینتی خانواده خرزهره است. به منظور بررسی تاثیر آب‌های مختلف روی میزان عناصر غذایی خاک و اندام هوایی پروانش، آزمایش فاکتوریل بر پایه طرح کاملا تصادفی در ۳ تکرار اجرا شد. تیمارهای آزمایشی شامل: نوع آب (آب شهر مغناطیس شده، آب شهر، آب چاه مغناطیس شده و آب چاه) و دورهای آبیاری (۲، ۴، ۶ و ۸ روز یکبار) بودند. در این مطالعه صفاتی از قبیل عمر گلدانی، ارتفاع بوته، تعداد برگ، مقدار ازت، فسفر و پتاسیم خاک و گیاه مورد ارزیابی قرار گرفت. بر طبق نتایج بیشترین عمر گلدانی(۴۲/۲۳ روز)، ارتفاع بوته (۲۱/۷۱ سانتی‌متر) و تعداد برگ (۱۶۵/۸۸) مربوط به تیمار آبیاری ۲ روز یکبار با آب شهر مغناطیس شده بود. بیشترین مقدار ازت گیاه نیز به تیمار آبیاری ۲ روز یکبار با آب چاه مغناطیس شده (۰/۳۲ میلی‌گرم در لیتر) اختصاص داشت. تیمارهای آبیاری ۸ روز یکبار با آب چاه و شهر مغناطیس نشده بیشترین مقدار ازت خاک را داشتند. بیشترین مقدار پتاسیم گیاه با ۵۶/۲۱ میلی‌گرم در لیتر در تیمار آبیاری ۲ روز یکبار با آب چاه مغناطیس شده بدست آمد. بیشترین مقدار فسفر گیاه با ۳۹/۵ و پس از آن ۳۸/۸ میلی‌گرم در لیتر به‌ترتیب مربوط به تیمارهای آبیاری دو روز یکبار با آب چاه مغناطیس شده و آبیاری دو روز یکبار با آب شهر مغناطیس شده بود

کلید واژگان: دورهای آبیاری، میدان مغناطیسی، گیاه زینتی، کیفیت آب.