The Effects of Using Magnetic Treatment Brackish Water in Irrigation on the Yield Medical Herbs "Origanum Vulgare" Pilot Project: AL-Uja Area/Lower Jordan Valley-West Bank

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Abstract— *Over abstraction of groundwater and limitation of natural recharge in the Lower Jordan Valley are causing an increase in groundwater salinity. The high demand for medicine herbs at international market attracted Palestinian farmers to grow medicine herbs including Oregano. Pilot project was carried out under greenhouse condition where magnetize technology introduced for the first time in irrigation of Oregano to overcome salinity problem. Using of magnetized treated water caused an increase of about 26% in the yield. Positive significant different for the favorite of Oregano irrigated with magnetized water compared with controlled in term of major branches, water content, number of surviving seedling and chlorophyll content. A decrease in the number of clogged dripper was found under treated magnetized water compared with controlled condition.*

Keywords— Magnetized water, Oregano, Water salinity.

I. INTRODUCTION

Al Uja area locates in the Lower Jordan Valley area, about 5 km to the north of Jericho city at about 280 m below sea level. The area considers an excellent agricultural site due to the fertile, availability of water and its warm climate during winter months. This location makes it unique to grow different crops during winter season. The major sources of irrigation water are the Al Uja spring with annual discharge range between 0.5 and 8 MCM of fresh water (0.7 mS/cm), and 7 Groundwater boreholes with average annual abstraction of 3.5 MCM of brackish water (2.5-6 mS/cm) (Hötzl and Wolf, 2011). Al Uja spring drain water from the karstic Mountain carbonate aquifer system with high fluctuation in discharge rate (Schmidt et al, 2013) (Guttman, 2007), this cause dependent on brackish groundwater. Increase of groundwater salinity is causing restriction of planting certain crops and limited to high tolerate salinity crops with relatively low cash income (Manasra et al, 2013). During the last decade Palestinian farmers start to grow medicine herbs for external market. In 2015, 60 tones of medicine herbs are exported from the Jordan Valley area (Data Base Ministry of Agriculture), from this Oregano cultivation make about 70 % of the exported Medicine Herbs. The study aim to assist applying treated magnetized water in irrigation of Oregano.

Herbs like Oregano, Thymine, Tarragon, Salvia, Rosemary, and other medical plants are well known herbs by the population in the Eastern Mediterranean Basin, and are historically still used in tradition medicine since many centuries (Azaizeh et al, 2006; Saad et al, 2005; Yeşilada et al, 1995). Medical herbs are also used in cosmetic, herbal tea, species, liqueurs, insecticides, fungicides and pharmaceutical industry. The essential oils can inhabit the growth of moulds and food borne bacteria (Paster et al, 1990). (Alçiçek et al, 2004; Symeon et al, 2009), reported also an improvement of broiler growing by adding wide medical herbs to the dietary.

In European, the cultivated area with medical herbs was about 70000 hectares in 2013(Spychalski, 2013) . France, Hungary and Spain are the main producers. Other hand Europe countries imported in 1996 about 440 000 ton of medical herbs which is about ¼ of the global production at a value of 1.3 billion US$ (Farnsworth and Soejarto, 1991; Lange, 1998)

In the West Bank/Palestine, the natural growing locations of these herbs are along the mountain ridges where semi humid to semi arid climatic zones dominates. In this zones the annual rainfall is above than 350 mm (Azaizeh et al, 2006). Due to the high demand of the international markets, and the good prices especially during winter season, Palestinian farmers started to cultivate this type of crops since the last decade in the Lower Jordan Valley. Oregano cultivated land in the western part of the Jordan Valley (West Bank) increase from 4 hectares to 20 hectares during the year 2015 (Ministry of Agriculture 2015).

To overcome the negative impact of saline water in irrigation of different crops. The United Stated Agency for International Development (USAID) started pilot projects of using magnetized treated brackish water in irrigation of different crops including medical herbs, namely Oregano, and Tarragon in Al Uja area. The selection of these crops is due to the high demand in international market, the climate of Jordan Valley during winter season provide earlier production comparing to other producing regions which start the production during last spring and in summer season. The main objective of this study was to assist the affect of using magnetize treated water in irrigation of on the yield of Oregano under green house condition.

Many authors reported a positive effect of using treated magnetized water in irrigation of different crops, for example (PIRZAD et al, 2013) reported an improvement of using magnetic saline water on germination and seedling growth of Lathyrus Sp.(Ul Haq et al, 2012) reported also an increasing in seedling growth, yield, plant height, root mass of Radish using Pre-sowing magnetic field water treatment. (Abdul Qados, 2011) also reported an improvement irrigated Lentil plant with treated magnetic water in term of plant height, fresh and dry weight, water contents chlorophyll a , a+b, total pigment, total phenol. (Maheshwari and Grewal, 2009) studied the effects of using magnetic treated water with different salinity contents on irrigation of snow pea, celery and pea plants, he reported a significant increase in plant yield and water productivity. (Nasher, 2008) reported also an increase on the growth of chick-pea crop. (El-Latif et al, 2014) studied the effect of exposing the maize seedling, and he reported that the highest growth rate of maize roots to 5 mT magnetic fields, as well as on root growth.(Aladjadjiyan, 2002; Esitken, 2003; Kinouchi et al, 1996) reported that using magnetized water can decrease the soil alkalinity, increase the mobility of fertilizers, and increase the yields. (Bogatin et al, 1999) studied the effect of magnetic treatment of irrigation water on the quality of irrigation, and he found that the flow rate through the apparatus, water carbonate hardness of more than 50 mg and pH value of more than 7.2 are important factors affecting the impact of treatment.

II. MATERIAL AND METHODS

The pilot project was carried out in cooperation with THIMAR-company in Al Uja area. For each crops (Oregano, and Tarragon) two green houses were selected to study the effect of using magnetized treated water in irrigation. The selection criteria followed the randomized experiment design, where two green houses with an area of 500 m² for each, 3 m high, 10 meter width and 50 meter length were selected to represent treated and controlled blocks "Table 2". To avoid any effect of treated magnetized water on the controlled block, treated greenhouses were irrigated through a separate irrigation system.

The pilot project was conducted between October 2012 and April 2013 in Al Uja area/Lower Jordan valley. "Table 1" summarizes characteristics of the pilot project. Soil pH-value was 7.5, the electrical conductivity of the soil was 550 µS/cm. Soil consist of 44% sand, 42% silt and 14% clay, and the soil texture consider as Loamy soil type. This pilot project study is one five USAID- pilot projects sites across the LJV for studying the effect of using treated magnetic water in irrigation of different crops (Bell Pepper, Beans, Oregano, Tarragon, Seedless Grapes, Date trees).

TABLE 1
CHARACTERISTIC OF OREGANO HERBS PILOT PROJECT SITE IN Al Uja

Item	Description	Item	Description
Soil type	Loamy soil	Type of cover	Greenhouse
Water salinity	3.45 mS/cm	Growing duration	September 2012 until April 2013
Total volume of irrigated treated water	325 m³/ 500 m ²	Total volume of irrigated non treated water	325 m³/500 m²
Irrigation method	Drip irrigation	Water salinity	3.45 mS/cm
No. of traced treated Plants	25	No. of traced control Plants	25

Two blocks of green houses with total area of 1000 m² were selected randomly to conduct the Oregano plantation; both greenhouses have the same soil type and the same dimensions. One block was irrigated with treated magnetized water, where the controlled one was irrigate with non treated water. Due to the fact that farmers do not measure indoor temperature or indoor relative humidity, no measurements of these two parameters were carried out. The two blocks were handling under the same conditions concerning fertilizers, pesticides and harvesting method. Water salinity was checked in the field in a regular base every 10 days, where no remarkable changes are noticed.

Water taped from 110 m deep borehole, with an average temperature of 18 ºC and average groundwater salinity of 3.45 µS/cm at 25 ºC. This water pass through a magnetic tube-device from Aqua 4-D-company with a maximum discharge rate of 20 m³/h. Magnetized water had to flow only 5 to 15 meters distance to reach the target green houses. Pre-treatment of the

treated block soil with magnetized water was carried out before plantation of Oregano seedling tock places. Fifteen cubic meters of treated magnetized water was applied in irrigation for this phase.

The plantation was conducted at the 10 of October 2012 for Oregano crop, where the first harvesting date was at the 3 of January 2013. Representative Oregano seedling was selected and traced randomly to present the seedling development in both treated and controlled blocks. These traced seedlings are used to measure the seedling height started after 20 days of plantation. The final number of monitored representative seedlings (m) was justified depending on the acceptable degree of error (e=5%). Seedling height was measured every three days. Flowing formula was used find out the optimum seedlings number ($m=(Cv/e)^2$, where : m: the optimum number of samples, e: is the degree of error.(5%), Cv: is the coefficient of variation is determined by: $Cv=(\sigma/X\text{-avg})*100\%$. Where σ: is the standard deviation. X-average: is the average of seedling height).

Drip irrigation method is applied in watering the Oregano seedlings. The irrigation scheduling was applied by the farmer in a form business as usual. The total volume of water applied for each block was 325 m^3. During the same period, the same recommended fertilizers were applied equally to both treated and controlled blocks.

Plant height, number of branches (major and minor), yield were registered in the field, where chlorophyll content, shelf time were carried out at the Environmental Research lab at Al Quds University (AQU) "Table 3". The volume of water used in irrigation of controlled and treated blocks was calculated based in m^3/0.1 hectare area. Water productivity was calculated based on fresh weight of Oregano in kg/m^3 of water used. SPSS-software (Coakes and Steed, 2009) was used in analyzing the collected data, where t-test and t-samples paired test was applied.

TABLE 2
TYPE OF MEASUREMENTS CARRIED ON OREGANO CROP

Parameter	Method
Plant height,	Metric method in the field
Number of branches	Manually counting in the field
Dry weight of root	Using balance with uncertainty of 0.5gm
Shelf time	Using special bag to conserve the herbs in refrigerator

Two type of statistical test were used ; the first test is the Independent test: the normality assumption of the studied parameters is tested according to (Shapiro and Wilk, 1965), if its normal distributed, the independent t-test was applied, and when it's not normally distributed the equivalent nonparametric test was applied (Mann-Whiteny test (Tallarida and Murray, 1986). The second test is the Related Test: in this method the normality assumption of the studied variables was tested according to Shpiro Wilk test. The appropriate test was used to check the difference between each variable in control and treatment samples, if its normal distributed, the paired sample t-test was used, and when the distribution was not normal the equivalent nonparametric test was applied by (Gehan, 1965).

III. RESULTS AND DISCUSSION

"Table 3" summarizes the main results of using treated magnetized water in irrigation of Oregano. The number of survived seedlings under treated water was higher than that under controlled conditions; this is due to the fact that clogging of dripper under treated is less than under controlled. A clear positive effect of using magnetized treated water on the yield based on the weight of fresh product. The yield of 0.5 hectare irrigated with treated magnetic water was 495 kg and that for controlled greenhouse was 392 kg, so irrigation with magnetized treated water caused an increase in the yield of about 26% in yield "Table 3".

TABLE 3
CULTIVATED AREA, NUMBER OF SEEDLING, AND YIELD IN KILOGRAM

	Control	Treated
Area in m^2	500	500
No. of seedling in greenhouse	3285	3302
Yield in kg	392	495
Yield/Seedling in gm.	119	150
Difference in yield in kg/0.05 hectare	103	
Difference in %	26%	

Water production per one cubic meter for Oregano during the growing season 2012/2013 was 1.5 kg by using magnetized treated water, and 1.2 kg for non treated water. This result shows that there is a clear increase in the water productivity based on the yield by applying magnetic treated water. Based on 2014 data where about 15 hectares of Oregano were cultivated under greenhouses condition in the Lower Jordan Valley. Assuming that the average yield is 495 kg/0.05 hectare by irrigation of treated magnetized water, the total production of 15 hectares could be 148.5 tons instead of 117.6 tons under non treated water.

100 grams were selected randomly from each sampling campaign. Samples we stored at 4 ºC, Oregano samples were daily observed and evaluated, and after twelve days of storing. Results, show that no clear differences of the shelf time between treated and controlled was registered, both samples became damage within the same time span "Table 4".

TABLE 4
SAMPLING DATE, AND DURATION OF SHELF TIME ANT 4ºC

Date of sample	Type of sample	Date of damage
15/1/2013	T	27/1/2013
	C	27/1/2013
20/3/2013	T	2/4/2013
	C	2/4/2013
4/8/2013	T	16/8/203
	C	16/8/2013

The height of representative seedling samples was measure in the field. "Table 5" summarized a comparison between the treated and the controlled samples. At the beginning of the sampling a significant difference (less than 0.05) between the numbers of major branches for the advantage of treated seedling during the sampling campaign 20-11, 28-11, and between 5-12, and 12-12/2013. This means that the number of major branches of Oregano seedling irrigated with magnetized water is more than that non treated water. By comparison the number of minor branches, it was found that there is no significant difference between the minor branches between treated and controlled samples.

TABLE 5
SUMMARIZED RESULTS OF DIFFERENT PARAMETERS (H: HEIGHT, MAJOR BRANCH, MINOR BRANCH)

	Independent T-test		Related Samples test	
Variable	Significant value	significant or not	Significant value	significant or not
H1	0.182	not significant	0.222	not significant
H2	0.273	not significant	0.143	not significant
H3	0.883	not significant	0.627	not significant
H4	0.128	not significant	0.147	not significant
H5	0.216	not significant	0.153	not significant
H6	0.613	not significant	0.513	not significant
Major B1	0.878	not significant	0.630	not significant
Major B2	0.027	significant (treatment>control)	0.062	not significant
Major B3	0.002	significant (treatment>control)	0.019	significant (treatment>control)
Major B4	0.001	significant (treatment>control	0.009	significant (treatment>control
Major B5	0.000	significant (treatment>control	0.014	significant (treatment>control
Major B6	0.001	significant (treatment>control	0.022	significant (treatment>control
Minor B1	0.213	not significant	0.151	not significant
Minor B2	0.953	not significant	0.775	not significant
Minor B3	0.082	not significant	0.128	not significant
Minor B4	0.332	not significant	0.502	not significant
Minor B5	0.225	not significant	0.219	not significant
Minor B6	0.264	not significant	0.191	not significant

Four fresh Oregano samples were dried at 25 ºC (room temperature) for twelve days. "Table 6" presents the fresh and the dry weight after twelve days in gram. The result indicate that treated Oregano contain higher percentage of water of about 60% where water content in controlled samples is about 56%. This phenomenon is one parameter that explains the higher weight of treated crop that reflected in a form of yield.

TABLE 6
BIOMASS OF FRESH AND DRY OF OREGANO HERBS AFTER 12 DAYS

Date of sample	Type of sample	Fresh weight(gm)	Dray weight(gm)	% of weight losses
15/1/2013	T	100	40	60%
	C	100	45	55%
2/4/2013	T	70	30	57%
	C	70	35	50%
11/4/2013	T	100	40	60%
	C	100	45	55%

Four random bulk samples of Oregano leaf were collected and analyzed for its total chlorophyll contents. Results are tabulated in "Table 7", where the average chlorophyll content in treated leafs was 1.86 mg/g and for the controlled leafs 1.34 mg/g. Finding results show that there is significant difference (less than 0.05) between chlorophyll content between treated and controlled sample for the advantage of treated samples.

TABLE 7
TOTAL CHLOROPHYLL CONTENTS IN mg/0.2g

Date/samples		Chlorophyll contents (mg/0.2g)
23/5/2013	Treated	1.78
	Control	1.53
29/5/2013	Treated	1.86
	Control	1.44
5/6/2013	Treated	2.26
	Control	1.08
11/6/2013	Treated	1.53
	Control	1.31
Average	Treated	1.86±0.30
	Control	1.34±0.20

Drip irrigation is widely used in the region, Palestinian farmers use this irrigation method in order to save water and to increase crop yield, and to avoid accumulation of salt on the soil surface. The discharge of each dripper depends on the water pressures, and on the condition of the dripper outlet, in this case it was 2 liter/hour. Water temperature and pressure can affect the dripper discharges which influence at the end the crop yield. Groundwater in the pilot project area is saturated with respect to carbonate minerals such as calcite (Marie and Vengosh, 2001). Changing in water condition (temperature, pressure, pH-value) will cause precipitation of carbonate minerals (calcite) at the outlet of the dripper (Hem, 1985) . After two months of irrigation, it was found that only 37 dripper from the 3600 total drippier are blogged under the treatment and 57 dripper are blogged under control conditions. This can explain that within the same period the number of damaged seedling was 595 and 629 seedlings in the treated and controlled conditions respectively. The positive effect of magnetic water by avoiding precipitation of carbonate minerals (calcite and aragonite) was reported by many authors (Banejad and Abdosalehi, 2009; Parsons et al, 1997)

IV. CONCLUSION

Using of magnetized water technology in irrigation of Medicine Herbs (Oregano) in the Lower Jordan Valley area that suffer from rising of groundwater salinity could be a temporary solution to overcome salinity constrain. Results show that improvement in number of seedling, height, major branches, water content, and chlorophyll content of Oregano irrigated with magnetized water comparing with controlled Oregano, these are reflected by increasing yield of about 26%. Also using magnetized treated water show positive effect on preventing dripper clogging.

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