Effect of Magnetic Water and Different Levels of NPK on Growth, Yield and Fruit Quality of Williams Banana Plant

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Abstract: A field study was carried out during two successive seasons to study the effect of irrigated banana plant with or without magnetic water of different levels of NPK (100 and 80 % from recommended dose) under salinity condition on growth parameters of Williams banana plants. The comparison between actual irrigation water by farmer and calculate Irrigation water was studied in this experiment. The experimental design was complete randomized block with three replications. Results show that: Irrigation with magnetic water significantly increased the growth parameters, yield, fruit quality of Williams banana plant. Also, the rate of NPK (80 % from recommended dose) had a positive increment on all studied parameters and give the similar trend with the recommended dose compared with untreated plants. Growth parameters of plant i.e. pseudostem height, circumference, number of green leaves and leaf area at bunch shooting stage significantly increased by irrigated with magnetic salty water. Time of flowering, harvesting and life cycle of plants tended to decrease with magnetic water. Drip system shortened the life cycle duration of Williams banana. Irrigation water use efficiency (IWUE), was affected with the rate of 100 NPK of fertilizer under magnetic saline water conditions. The highest irrigation water use efficiency (1.87 and 1.83 kg/m^3) was obtained with Magnetic+100% NPK.This result was due to improve yield by using the magnetic water not due to save irrigation. The different between actual irrigation water by farmer in the field and calculation irrigation water need was about 1910 and 1960 cubic meter per fad for first and second season respectively.

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Key words: banana, Magnetic water technique, yield, fruit quality

1. Introduction

Banana and plantain (Musa sp.) is a crop of tremendous economic social importance in the humid and sub humid tropical region of the world (**Robinson 1996**). Banana is a plant with a rapid growth rate, high consumption of water, shallow and spreading roots distribution, roots with weak penetration strength into the soil, poor ability to draw water from drying soil, low resistance to drought, and rapid physiological response to soil water deficit. **Simonds (1980)** reported that banana cannot withstand frost, and chilling injury occurs at temperature below 12°C. Growth begins at about 18 °C, reached an optimum at 27 °C, then declined and came to a stop at l2 °C and 38°C and fruits increase in girth up to 29 °C. In respect of water use, the banana plant has several important characteristics: A high evapotranspiration rate due to large broad leaves and large total leave area, a shallow, superficial root system compared with most tree fruit crops. a poor ability to withdraw water from a soil which is drying out and rapid physiological response to soil water deficit especially in conditions of high evaporation stress (**Robinson and Villiers, 2007**). Irrigation water use efficiency, IWUE (irrigation water productivity), defined as the ratio of the crop yield (t /ha) to seasonal irrigation water (mm) applied, including rain. **Zeng *et al.* (2009)** found that the lower amount of irrigation water applied, the higher irrigation water use efficiency obtained.

These factors indicate that banana is sensitive to even slight variations in soil water content and that irrigation scheduling is critical. A magnetic water treatment device has been developed and used on banana plants to check its effectiveness. Magnetic treatment changes the physiochemical characteristics of soil leading to improved dissolvability of different chemical elements, more salts out of the soil and at the same time increasing oxygen concentrations by 10 % (**Behrouz and Mojtaba, 2011**).

There is hardly any study reported with valid scientific experiments, on the effects of magnetic treatment of water on crop yield.However, some beneficial effects of magnetic field have been reported on closely related studies in a number of farming situations. The observations on quality assessment indicate that magnetic treatment enhances the overall physical characteristics of the fruit. It has also been observed that magnetically activated water used in agriculture helps for improvement of germination, plant growth, flowers, fruit and crop yield. This also prevents from forming white salty deposits near the plant (**Ajitkumar, 2014**).

The purpose of this study was to evaluate growth, yield and water use- efficiency as affected by different level of NPK (100% and 80 % from recommended dose) irrigated with magnetic salty water of banana plant (Williams cultivars). Comparison between actual irrigation water by farmer and calculate Irrigation water.

2. Materials and Methods

A field experiment was conducted in El- Khatatba region, Minufiya Governorate, Egypt, during two seasons of 2012/2013 (First ratoon) and 2013/2014 (second ratoon) on Williams banana plant (*Musa cavendishii* L.) produced through tissue culture technique to study the effect of magnetic saline water with different rate of NPK fertilizers on same vegetative growth, yield, fruit quality, fruiting, flowering and leaf chemical constituents. Banana plants were cultivated in 3× 3.5 meters apart, similar in growth, free diseases and received the same horticultural managements. Soil texture in this study was sandy textured. Moreover mechanical and chemical analyses of the experimental soil from 0-60 cm. depth was determined according to the methods described by to **Wild *et al.* (1985)** and data are shown in Table (1). The analysis of well water which used in the experiment before and after magnetic device (6 inch, 8500 Gawes, made in USA) in the first season in Table (2).

Table (1): Physical and chemical analysis of orchard soil (0 – 60 cm, depth) during season of 2012.

Clay %	4.35	Mg^{++}meg/L	13.8
Silt %	3.40	SO_4^{--} meg/L	37.5
Sand %	90	Cl^- meg/L	2.88
Texture	Sand	HCO_3^- meg/L	6.87
Ec mm hos/cm 1:2.5	4.3	SP	30
pH	7.76	Ca^{++} meg/L	20.64
Organic matter%	0.65	Na^+ meg/L	1.11
K^{++} meg/L	11.7		

Table (2): Chemical analysis of well water during season of 2012.

	K^{++}	Na^+	Mg^{++}	Ca^{++}	SO_4^{--}	Cl^-	CO_3^{--}	HCO_3^-	Ec	SAR
	meg/L								**M mole L-1**	
Before	0.56	13.48	2.10	3.74	7.89	10.37	0.0	1.62	1.98	7.88
After	0.5	13.48	2.15	3.65	7.89	10.12	0.0	1.62	1.98	7.88

Climate data

The daily metrological data (maximum and minimum air temperature, relative humidity) from El-Khatatba region, Minufiya Governorate was recorded from weather station during the first and second seasons (2013-2014)**.** Date presented in Tables (2 & 3).

Table (2): Monthly Maximum and minimum air Temperature for El- Khattba region, Mynofia Governorate during the study period 2013 and 2014 seasons

Month	T max 2013	T min 2013	T max 2014	T min 2014
January	13.0	9.0	12.0	10.2
February	16.0	11.7	16.3	11.4
March	20.0	14.5	22.0	15.3
April	25.0	14.3	28.0	16.6
May	30.0	14.1	32.0	17.0
June	33.0	16.5	33.5	21.1
July	36.0	21.9	36.9	22.4
August	35.0	21.0	34.2	20.0
September	34.3	17.8	33.1	16.6
October	30.2	14.6	30.5	15.5
November	25.0	15.8	22.5	17.2
December	20.0	10.2	19.3	8.8
Average	**26.5**	**15.1**	**26.7**	**16.0**

Table (3) Monthly average relative humidity (RH) for El- Khatatba region, Minufiya Governorate during the study period 2013 and 2014 seasons

Month	RH 2013	RH 2014
January	44	40
February	49	48
March	50	48
April	45	49
May	53	51
June	60	55
July	62	61
August	60	60
September	57	59
October	45	47
November	39	42
December	40	41
Average	**50.3**	**50.1**

Fifteen of Williams banana plants each in separated stool, were chosen and arranged in complete randomized block design on three treatments with three replication. Each treatment was represented by five replicates, each replicate was represented by one stool. In the first season, each stool yielded three suckers. Also, in the second season, each stool yielded three suckers.In both seasons, the experiment included 3 treatments as follows:

1- The control (without magnetic treatment) fertilized with 100 % recommended NPK mineral fertilizers, i.e. 400 kg N/fed. (1200 Kg ammonium nitrate 33.5 % N / fed./year), 50 kg P_2O_5 /fed. (250 Kg calcium superphosphate 15.5% P_2O_5 / fed./year and 52 mL. phosphoric acid 80% /fed./year) and 800 kg K_2O / fed. (1600 Kg potassium sulphate 48% K_2O / fed. /year.)

2- 100 % of the recommended NPK fertilizers plus magnetic water.

3- 80 % of the recommended NPK fertilizers plus magnetic water

Growth characters: At bunch shooting stage, (fourteen months after cultivation) the following growth characteristics were recorded in each season: pseudostem height (cm) was measured from the soil surface up to the petiole of the last emerged leaf, pseudostem girth (cm) was measured at height of 20 cm above soil surface, number of green leaves per plant as well as leaf area (m^2) of the third leaf from the top was calculated as described by **Murry (1960)**.

Leaf chemical constituents : From each treatment, a 10 cm^2 from the third leaf from the top of the plant in each individual plant at bunch shooting stage was taken as recommended by **Hewitt (1955).**Total nitrogen was determined by Micro-Kjeldahle method as described by **Jackson (1973)**,Phosphorus was determined according to the method of **Chapman and Pratt (1961)** and K was determined by using the Atomic Absorption Spectrometer (Per Kin – Elemer, Model 3300) according to the methods described by **Chapman and Pratt (1961).**

Flowering:

1- Time to flowering: the period from sucker emergence to bunch shooting (in days) date was calculated in the tested seasons.

2- Time to harvesting: the period from bunch shooting to date of harvesting (in days) was calculated.

3- Cropping cycle (life cycle duration): It was calculated (in days) from sucker emergence to date of harvesting

Yield and bunch characteristics: at time of harvesting bunch weight in Kg., number of hands/bunch, finger weight, finger length and diameter were counted and recorded.

Actual irrigation water in the field

The total amount of actual irrigation water was measured by water flow-meter installed in the three different row. Each row content eight Banana plants and the distance between plant was in 3 meter apart and the plant was similar in growth and free diseases.The data for each water flow-meter was collect monthly during the two seaseons.

Evapotranspiration Calculation

Evapotranspiration was calculated, for El-Khattba region, Mynofia Governorate during the studies seasons using Food and Agricultural Organization (FAO) Penman- Monteith (PM) procedure, FAO 56 method, presented by (**Allen *et al.*, 1998**). In this method, ETo is expressed as follows:

$$ET = \frac{\Delta(R_n - G) + \rho_a c_p (e_s - e_a)/r_a}{\left(\Delta + \gamma\left(1 + \frac{r_s}{r_a}\right)\right)\lambda\rho_w}$$

where ETo is the daily reference evapotranspiration (mm day-1), Rn is the net radiation at the crop surface (MJ m-2 day-1), G is the soil heat flux density (MJ m-2 day-1), T is the mean daily air temperature at 2 m height (ºC), U2 is the wind speed at 2 m height (m s-1), es is the saturation vapor pressure (kPa), ea is the actual vapor pressure (kPa), Δ is the slope of vapor pressure curve (kPa ºC-1) and γ is the psychometric constant (kPa ºC-1).

Calculated of Irrigation water requirements for Banana

The effects of the various weather conditions are incorporated into the ETo estimate. Therefore, as ETo represents an index of climatic demand, Kc varies predominately with the specific crop characteristics and only to a limited extent with climate. This enables the transfer of standard values for Kc between locations and between climates. This has been a primary reason for the global acceptance and usefulness of the crop coefficient approach and the Kc factors developed in past studies. ETc is determined by the crop coefficient approach whereby the effect of the various weather conditions are incorporated into ETo and the crop characteristics into the Kc coefficient. In the crop coefficient approach the crop evapotranspiration, ETc, is calculated by multiplying the reference crop evapotranspiration, ETo, by a crop coefficient, Kc according to FAO 56 banana crop coefficient as shown in table 4, the same methodology adopted by many studies (**Allen *et al.*, 1998, Gafar, 2009**).

Table (4): FAO (56) banana crop coefficient

	Kc_{ini}	Kc_{mid}	Kc_{end}
First year	0.50	1.10	1.00
Second year	1.00	1.20	1.10

Source: FAO-56 documentation table 12

$$IR = K_c * ET_o * LF * IE * R* Area (Feddan)/1000$$

Where:

IR = Irrigation requirement (m^3/feddan).

K_c = Crop coefficient [1.0-1.20-1.10] according to (FAO 56- Second year).

ET_o = Reference crop evapotranspiration [mm/day].

LF = Leaching fraction (assumed 20% of irrigation water).

IE = Irrigation efficiency of the irrigation system in the field, (assumed 85% of the total applied).

R = Reduction factor (90 % cover in this study)

Area = the irrigated area (one feedan = 4200 m^2).

1000 = to convert from liter to cubic meter.

Irrigation water use efficiency (IWUE)

The irrigation water use efficiency (IWUE) was calculated according to **FAO (1982)** as follows: The ratio of crop yield (y) to the total amount of irrigation water use in the field for the growth season (IR),

IWUE (Kg/m^3) = Y(kg / feedan) / IR (m^3)

Statistical analysis:

The experimental data were tabulated and statistically analyzed according to **Snedecor and Cochran (1980)** and the differences between mean various treatments were compared by using L.S.D. at 5% level of probability.

3. Results and Discussion

Vegetative growth

Overall, irrigating with magnetic water significantly increased the vegetative growth of Williams banana plant. From the results in Table (5) showed that, no significant differences in vegetative growth parameters fertilized with either 100 % or 80% NPK under magnetic treatment. Yet the pseudostem height tented to increase with magnetic salty water supply under any rate of NPK fertilizers. The highest value recorded 294.30 and 298.25cm with the rate of 80% NPK as compared with control one (243.36 and 179.19 cm) in both tested seasons.

As for, the highest value of pseudostem girth were noticed with the magnetic salty water under any rate of NPK. The narrowest pseudostem girth was show with plant fertigated with the rate of 80% NPK only.

Number of green leaves sprout on the plant, Number of suckers and leaf area at bunch shooting stage increased with magnetic salty water under any fertilization rate. The rate of 80 % NPK with magnetic salty water increased the emerged green leaves (11.40 & 11.00 leaf/plant), number of suckers (3.80 & 3.80 sucker/plant) and leaf area (1.82 &1.81 m^2 /plant) in comparison with the control (8.16 &5.74 leaf/plant), (3.80 & 3.80 sucker/plant) and (1.38&1.04 m^2/plant) in Williams Ziv cultivars in tested seasons respectively. This results agreement with **Amira *et al.* (2010)** who found an increase in several parameters of common flax, and **Sadeghipour and Aghaei (2013)** managed to increase yield/plant by 9.1%.

After irrigation with magnetic water. Such results are in accordance with **Mohamed (2013)** who found that magnetic water improved fresh and dry weights of tomato plant compared to control. It appears that utilization of magnetized water technology may be considered a promising technique to improve tomato yield productivity. He also, concluded that the use of magnetic techniques with low quality water is very important for irrigation without any expected problems in the soils and plant. The beneficial effect of magnetic water may be due to the influence of ions activation and polarization of dipoles in living cell. Magnetic water can alter the plasma membrane structure and function.

Table (5): Effect of magnetic water and different NPK levels on vegetative growth during inflorescence emergence of Williams banana plants in 2012/2013 and 2013/2014 seasons.

Treatment	Psedostem		Leaf area m^2	No. of leaves	No. of suckers
	height(cm)	girth(cm)			
First season					
Magnetic+100 % NPK	294.30 a	98.00 a	1.81 a	11.20 a	3.40 ab
Magnatic + 80% NPK	294.30 a	88.00 a	1.82 a	11.40 a	3.80 a
100 %NPK	243.36 b	76.29 b	1.38 b	8.16 b	2.04 b
Second season					
Magnetic+100 % NPK	297.50 a	99.00 a	1.81 a	10.80 a	3.00 ab
Magnatic + 80% NPK	298.25 a	100.00 a	1.81 a	11.00 a	3.80 a
100 %NPK	178.19 b	54.98 b	1.04 b	5.74 b	1.66 b

Leaf mineral constituent

Results presented in Table (6) show that irrigation with magnetic water improved significantly nitrogen, phosphorus, potassium, calcium and magnesium percentage of banana plant as compared with nonmagnetic water in both seasons. No significant differences in vegetative growth parameters fertilized with either 100 % or 80% NPK. The highest value of N and P concentration were showed at the rate of 100 %NPK and recorded (3.08 and 0.218) in the first season while recorded (3.06 and 0.232) at the rate of 80 % NPK in the second season.Concerning of K, Ca and Mg concentration, data in Table (6) noticed that, the rate of 80 % NPK with magnetic salty water increased the K concentration (3.70 & 3.50 %), Ca concentration (1.92 & 1.204% and Mg concentration (1.82 &1.81 m^2 /plant) in comparison with the control (8.16 &5.74 leaf/plant) and (0.482 & 0.454 %) in Williams Ziv cultivars in tested seasons respectively. This results are harmony with Hilal and Hilal, 2000a and b who reported that magnetized water was shown to have 3 main effects: 1) increasing the leaching of excess soluble salts, 2) lowering soil alkalinity and 3) dissolving slightly soluble salts such carbonates, phosphates and sulfates. However, the degree of effectiveness of magnetized water on soil salinity and ionic balance in soil solution depended greatly on the traveling distance of magnetized water along the drip irrigation lines. On the other hand, **Tai et al. (2008)** observed that on subjecting water to magnetic field, it leads to modification of its properties, as it becomes more energetic and more able to flow which can be considered as a birth of new science called Magneto biology. They also pointed out that, magnetized water prevents harmful metals such as, lead and nickel, from uptake by roots and reaching fruits and roots. **Grewal and Maheshwari (2011)** reported that there are some changes occurred in the physical and chemical properties of water according to magnetic water, mainly hydrogen bonding, polarity, surface tension, conductivity, pH and solubility of salts, and these changes in water properties may be capable of affecting the growth of plants. They assumed that the reduction in water pH and increase in EC in magnetic water may be due to changes in hydrogen bonding and increased mobility of ions. **Maheshwari and Grewal (2009**) showed increased Ca and P concentrations in celery shoots and Ca and Mg concentration in snow pea pods under magnetic water.

Table (6): Effect of magnetic water and different NPK levels on macronutrients concentration (g/100g dry weight in leaves) of leaf chemical constituent during inflorescence emergence of Williams banana plants in 2012/ 2013 and 2013/2014 seasons.

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
First season					
Magnetic+100 % NPK	3.08 a	0.218 a	3.66 a	1.178 a	0.472 a
Magnetic + 80% NPK	3.04 a	0.206 a	3.70 a	1.192 a	0.482 a
100 %NPK	2.04 b	0.16 b	2.50 b	0.93 b	0.360 b
Second season					
Magnetic+100 % NPK	3.02 a	0.22 a	3.40 b	1.186 a	0.454 a
Magnetic + 80% NPK	3.06a	0.232 a	3.50 a	1.204 a	0.448 ab
100 %NPK	1.71 b	0.13 b	2.24 c	0.81 b	0.30 b

Growth cycle duration:

This part of study was concerned with life cycle duration i.e. the period from sucker emergence to bunch shooting (time to flowering), in addition, the period from bunch shooting to harvesting date (time to harvest) in response to magnetic water and treatments of fertilization.

Data in Table (7) show that the time of flowering, harvesting and life cycle of plants (cropping cycle) significantly varied due to magnetic water and fertilizing in the tested seasons. The tabulated data also show that, no clear differences could be defined between the 100 % and 80% rate of NPK treatments regarding time to flowering, harvesting and life cycle of plants.

Time to flowering, harvesting and life cycle of plants clearly decreased by irrigated with magnetic water. In this respect the rate of 80% NPK treatment was shortened the period to flowering (422.4 and 425.4 days), harvesting (97.2 and 102.6 days) and life cycle of plants (519.6 and 528) than control (time to flowering :427.8 & 427.5, harvesting: 97.2 & 119.4 and life cycle of plants: 525.0 & 536.9 days) in both tested seasons respectively.

Maheshwari and Grewal (2009) suggested an improved availability, uptake, assimilation and mobilization of these nutrients within plant system which may have contributed in improving the productivity of celery and snow pea plants with the magnetic treatment of water. **Duarte et al. (1997)** rq2ddaqw2aw32 reported an increase in nutrient uptake by magnetic treatment in tomatoes. A marked increase in P content of citrus leaves by magnetic water was also reported by **Hilal et al. (2002)**.

Bunch weight and yield

Bunch weight/plant and yield/Fed. Significantly varied in response magnetic water and fertilizing in the tested seasons. The tabulated data also show that, no clear differences could be defined between the 100 % and 80% rate of NPK.

The heaviest bunches/plant (or yield/Fed.) were produced in plants received the rate of 80% treatment under magnetic salty water (27.8 and 27.8kg. or 27.8 and 27.8 tons/Fed.) on both tested seasons, and the lightest bunches/plants(or yield/Fed.) were obtained from the plants irrigated without magnetic treatment.

Finger parameters:

Data in Table (7) show that finger parameters (finger weight, finger length and diameter) were significantly varied due to magnetic salty water and fertilization in both tested seasons. As such the highest values of finger parameters were noticed in plants irrigated with magnetic water while the lowest values of finger parameters were noticed in plants irrigated without magnetic. The longest finger (22.76 & 22.50cm), widest finger (3.12 & 3.28 cm) and heaviest finger (116.02 & 118.80 g) were obtained from plants with the rate 80% NPK under magnetic water whilst the shortest finger (14.89 & 12.68 cm), narrowest ones (2.45 &2.03 cm) and lightest finger (81.09 & 68.85 g) were obtained from untreated plants in both tested seasons, respectively.

Table (7): Effect of magnetic water and different NPK levels on period flowering, maturation, cropping cycle, fruit parameter, number of hand per bunch, bunch weight, yield and IWUE at fruit maturity stage of Williams banana plants in 2012/2013 and 2013/2014 seasons.

Treatment	Time to flowering (days)	Time to harvest (days)	Cropping cycle (life cycle duration)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Bunch weight (kg)	Yield per fed. (ton)	IWUE kg/m^3
First season									
Magnetic+100 % NPK	423.0 b	96.6 b	519.6 b	22.54 a	3.02 ab	116.20 a	27.80 a	27.80 a	2.47 a
Magnetic + 80% NPK	422.4 b	97.2 b	519.6 b	22.76 a	3.12 a	114.10 a	26.80 a	26.80 a	2.30 b
100 %NPK	427.8 a	97.2 a	525.0 a	14.89b	2.45 b	81.09	21.00 b	21.00 b	1.87 b
Second season									
Magnetic+100 % NPK	427.2 b	101.4 b	528.6 b	22.34 a	3.24 a	118.80 a	27.40 a	27.40 a	2.83 a
Magnetic + 80% NPK	425.4 b	102.6 b	528.0b	22.50 a	3.28 a	117.40 a	27.80 a	27.80 a	2.46 b
100 %NPK	427.5 a	119.4 a	536.9 a	12.68 b	2.03 b	68.85 b	20.60 b	20.60 b	1.83 b

IWUE= Irrigation water use efficiency

Reverence Evapotranspiration (ETo)

Data in Table (8) showed the average monthly evapotranspiration (mm/month) for El-Khattba region, Mynofia Governorate during the studies seasons. The evapotranspiration started with low value 1.92 & 1.72 mm during the January and then increased to a peak 6.84 & 6.99 mm/day in June. The average value of evapotranspiration of banana was 4.33 & 4.31 mm/day. These results agreed with **Allen *et al*. (2005)** who reported that there are a host of other variables that are related to temperatures which affect crop growth and yield, for example evaporation, transpiration, and vapor pressure deficit. Even solar radiation has been shown to be related to the diurnal air temperature difference.

Actual irrigation and Calculate irrigation

Results recorded in Tables (9) showed monthly Actual irrigation and calculate irrigation water m^3/ fed. monthly average actual irrigation water for banana were measured by water flow-meter. According to actual irrigation water one fed. of banana tacked about 11250 and 11269 cubic meter per fad. The monthly average calculates irrigation requirements for banana were resulted from multiplying the average monthly ETo by crop coefficient of banana. According to the current situation one fed. of banana calculate irrigation requirements need about 9340 and 9309 cubic meter of calculate irrigation water for El-Khattba region for first and second season, respectively. The comparison between actual irrigation water applied in the field and calculation irrigation water was about 1910 and 1960 cubic meter per fad. The highest monthly different between Actual and calculate water was found in May about 339 and 319 cubic meter per fad. This means that the farmer was gave a banana amount of water more than it needs and is sparingly in water. These results are in agreement with Khalifa **(2012)** who found that the quantities of water applied to banana plants were 30635 m^3/ha under drip irrigation.

Table (8): Monthly ETo (mm/ day) for El- Khattba region, Mynofia Governorate during the study period 2013 and 2014 seasons

Month	ETo 2013	ETo 2014
January	1.92	1.72
February	2.37	2.27
March	3.38	3.53
April	4.52	4.42
May	4.52	4.67
June	6.77	6.67
July	6.84	6.99
August	6.44	6.34
September	5.86	5.66
October	4.43	4.58
November	2.88	2.98
December	2.01	1.91
Average	**4.33**	**4.31**

Table (9): Comparison between actual irrigation water applied in the field and calculation irrigation water m^3/ feddan.

Month	Actual irrigation m^3/ feddan		Calculate irrigation m^3/ feddan		Difference m^3/ feddan	
	2013	**2014**	**2013**	**2014**	**2013**	**2014**
Jan	413	418	316	300	96	118
Feb	563	567	336	339	226	228
Mar	788	791	559	584	228	207
Apr	938	936	761	708	177	227
May	1163	1170	823	851	339	319
Jun	1350	1345	1246	1227	104	118
Jul	1425	1427	1358	1387	67	40
Aug	1313	1311	1279	1259	34	51
Sep	1200	1203	1031	996	169	207
Oct	975	978	806	833	169	145
Nov	675	679	507	490	168	189
Dec	450	447	318	335	132	112
Total	**11250**	**11269**	**9340**	**9309**	**1910**	**1960**

Irrigation water use efficiency (IWUE)

Date in Table (7) retrieved that the highest irrigation water use efficiency (2.47 and 2.43 kg/m^3) was obtained with Magnetic+100% NPK followed by (2.38 and 2.46 kg/m^3) without significantly difference between them. The lowest treatment was 100% NPK (1.87 and 1.83 kg/m^3) with significantly difference between other treatments. This result was due to improve yield by using the magnetic water not due to save irrigation. The average yield per plant in magnetically treated plot was 19 kg compare to its counterpart conventional plot was 15 kg (**Patil, 2014**).

Zeng et al. (2009) found that the lower amount of irrigation water applied, the higher the irrigation water use efficiency obtained.

Conclusion

From the obtained results it could be concluded that, irrigated banana plants with magnetic salty water led to produced healthy plant with good quality and could be decrease the chemical fertilized doses respectively in banana plant. Magnetic water technique led to improve crop yield productivity. The different between actual irrigation water applied in the field and calculation irrigation water need was about 1910 and 1960 cubic meter per fad. More studies need to irrigation eater need for banana. Before this technology can be recommended to farmers, could be need for more studies.

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