Minia J. of Agric. Res. & Develop.
Vol. (34), No. 2, pp. 165-181, 2014

FACULTY OF AGRICULTURE

EFFECT OF SOME AGRICULTURAL TREATMENTS ON THE MARJORAM PRODUCTION AND SOIL FERTILITY UNDERTHE NEWLY RECLAIMED SOIL CONDITIIONS

I. YIELD AND SOME NUTRIENTS UPTAKE

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Received: 24 Julay 2014 Accepted: 12 October 2014

ABSTRACT

The current study was carried out on a field scale during growth season (2012/2013) of marjoram (*Marjorana hortensis* L.) grown in the newly reclaimed soil to investigate the effect of applying biofertilizers in combination with some organic and inorganic nitrogen fertilizers under two irrigation systems (surface and drip). The experimental design included two systems of irrigation regimes, five mixtures of the organic and/or inorganic nitrogen fertilizers {100% inorganic (N), 75% inorganic (N) + 25 % organic (N), 50% inorganic (N) + 50 % organic (N), 25% inorganic (N) + 75 % organic (N), and 100% organic (N), and three levels of biofertilizers (0.0, yeast, and nitrobein) singly or in combination, making a number of thirtey treatments in four replecation. The obtained results shoned that The herb dry weight (ton/feddan) and oil yield (kg/feddan) are superior in the first cut as compared to the second and third cuts. The herb dry weight (ton/feddan) and oil yield (kg/feddan) were significantly superior in the use of drip irrigation as compard to the use of surface irrigation. The biggest significant value of the herb dry weight in all cuts was recorded using 100% inorganic nitrogen fertilization. On the other hand, the highest significant value of the oil yield in all cuts was recorded using 100% organic nitrogen fertilization. The herb dry weight (ton/feddan) and oil yield (kg/feddan) were significantly superior in the use of nitrobein as compard to the use of yeast. Applying 100% inorganic N or 75% inorganic N + 25% organic N with using nitrobein improved N, P, and K uptake by marjoram leaves under drip irrigation system. Generally, applying 75% inorganic (N) + 25% organic (N) with nitrobein under drip irrigation gave the best quality and quantity yield of marjoram

(*Marjorana hortensis* L.) cultivated in the newly reclaimed soils under conditions of El-Minia Governorate, Egypt.

Key words: Marjoram plants, Surface irrigation, Drip irrigation, Organic fertilization,
Inorganic fertilization, Biofertilization

INTRODUCTION

Medicinal and aromatic plants use by 80% of global population for their medicinal therapeutic effects as reported by WHO (2008). Many of these plants synthesize substances that are useful to the maintenance of health in humans and other animals. These include aromatic substances, most of which are phenols or their oxygen-substituted derivatives such as tannins. Others contain alkaloids, glycosides, saponins and many secondary metabolites (Naguib, 2011). Marjoram, (*Marjoram hortensi* L.) is a hardy perennial and herbaceous plant which grows in many areas Egypt and eastern Mediterranean countries. Commercial *Origanum majorana* L oil (sweet marjoram) is used as a spice and condiment. Volatile oil produced by this plant is antispasmodic, digestive, bitter tonic, expectorant, diuretic, antidiabetic, antimicrobial, and antioxidant; it regulates menstruation and carminative astringent, antihysterical, antiasthmatic, antiparalytic drugs. In addition it is used in many industries. It is cultivated as culinary herb and as garden plants (Sivropoulou *et al*., 1996). Some properties like antimicrobial activities have been attributed to the essential oil from marjoram (Dapkevicius *et al*., 1998).

Surface irrigation method is commonly used in the area resulting in low irrigation efficiencies as well as salinity and drainage problems. Efficient use of water by irrigation is becoming increasingly important, and alternative water application methods such as drip and sprinkler, may contribute substantially for making the best use of water for agriculture and improving irrigation efficiency (Eker *et al*., 2007).

The trend in recent years has been oriented towards conversion of surface to drip irrigation, which is considered to be a more efficient delivery system. Scheduling water application is very critical to make the most efficient use of drip irrigation system, as excessive irrigation reduces yield, while inadequate irrigation causes water stress and reduces production. On the other hand, the intensity of the operation requires that the soil water supply be kept at the optimal level to maximize returns to the farmer. High-frequency water management by drip irrigation minimizes soil as a storage reservoir for water, provides at least daily requirements of water to a portion of the root zone of each plant, and maintains a high soil matric potential in the rhizosphere to reduce plant water stress (Phene and Sanders, 1976; Nakayama and Bucks, 1986). Drip or trickle irrigation is a very efficient method of applying water and nutrients to crops. For many crops, the conversion from sprinkler to drip irrigation can reduce water used by 50 percent. Crop yields can increase through improved water and fertility management and reduced disease and weed pressure (William *et al.*, 2002).

The cost of inorganic fertilizers is increasing enormously to an extent that they are out of rech of small and marginal farmers. The problems associated with the use of hazardous chemicals for crop production, weed control, and soil fertility are received increasing attention world wide since pests, diseases and weeds become resistant to chemical pesticides and environmental pollution and ecological imbalances may occur. Application of organic fertilizers has been a noble and traditional practice of maintaining soil health and fertility. The use of this organic fertilizers results in higher growth, yield, and quality of crops. They contain macronutrients, essential micronutrients, many vitamins, growth promoting factors like IAA, GA, and beneficial microorganisms (Natarjan, 2007; Sreenivasa *et al*.; 2010). Organic manures can improve soil-water-plant relations through modifying bulk density, total porosity, soil water relation and consequently, increasing plant growth and water use efficiency (Obi and Ebo, 1995). Recently, unconventional efforts are used to minimize the amount of chemical fertilizers which applied to medicinal and aromatic plants in order to reduce production cost and environmental pollution without reduction of yield.

Biofertilizers are reasonably safer to the environment than chemical fertilizers and play an important role in decreasing the use of chemical fertilizers. Consequently, it causes a reduction in environmental pollution. Soil inoculation with microorganisms may lead to increase soil available nitrogen and consequently increase formation of metabolites which encourage the plant vegetative growth and enhance the meristematic activity of tissues to produc more branches. Also, N-fixers synthesize stimulatory compounds such as gibberellins, cytokinins, and IAA that act as growth regulators (Sperenat, 1990 and Dadarwal *et al*., 1997).

The study aimed to evaluate the effect of inorganic fertilization in combined with organic manure as well as biofertilizers under two irrigation systems on yield and some nutrients uptake by marjoram plant.

MATERIAL AND METHODS

The study was conducted at the newly reclaimed land located in the Village No. 1, west district of Mattai, El-Minia Governorate, Egypt. A representative soil sample was collected from the experimental site at the depth of 0-30 cm. The sieved soil was mixed thoroughly and a subsample was taken and analyzed for the electrical conductivity, pH, organic matter, calcium carbonate, available nitrogen, available phosphorus, available potassium, soluble cations (calcium, magnesium, sodium, and potassium), soluble anions (chloride, sulphate, carbonate, and bicarbonate) as described by Jackson (1973), and the particle size distribution according to Piper (1950). Some physical and chemical properties of the studied soil are shown in Table 1.

The main source of irrigation water, whether surface or drip irrigation was from Bahr Yossuef Canal as a branch of River Nile, where the water was storaged in a big reservor and pumbed to the field using pumbing machine. The experimental design was spilt spilt in a completely randomized block with four replicates. The experimental design consisted of thirty treatments.

Table 1: Some physical and chemical properties of the studied soil.

Soil properties	Value
Physical properties:	
Particle size distribution:	
Clay (%)	10.11
Silt (%)	15.06
Sand (%)	74.83
Texture grade	Sandy Loam
Chemical properties:	
pH (1:2.5 soil-water suspension)	7.92
EC, soil paste (ds m^{-1})	1.65
Organic matter (%)	0.59
CaCO3 (%)	4.06
Available N (ppm)	2.15
Available P (ppm)	7.82
Available K (ppm)	9.29
Soluble cations (soil paste):	
Soluble Ca^{2+} (meq/l)	5.60
Soluble Mg^{2+} (meq/l)	5.39
Soluble Na^{+} (meq/l)	3.03
Soluble K^{+} (meq/l)	2.35
Soluble anions (soil paste):	
Soluble Cl^{-} (meq/l)	7.21
Soluble $SO4^{2-}$ (meq/l)	7.86
Soluble $CO3^{2-}$ (meq/l)	0.00
Soluble $HCO3^{-}$ (meq/l)	2.30

The experimental design included two systems of irrigation regimes, five mixtures of the organic and/or inorganic nitrogen fertilizers, and three levels of biofertilizers are illustrated in Table 2. The irrigation systems were allocated in the main plots. The organic and/or inorganic nitrogen fertilizers mixtures were allowed in the subplots, whereas the biofertilizers levels were settled up in the sub-subplots.

The compost used in the current study was collected from the Recycling of Solid Wastes, Egyptian Company, El-Minia Governorate, Egypt. A representative sample was taken from the compost. The dried and sieved compost was mixed thoroughly and a subsample was taken and analyzed for the pH, electrical conductivity, and organic carbon as described by Jackson (1973). While, total nitrogen, total phosphorus, and total potassium aswas determined described by Chapman and Pratt (1961). The chemical composition of the compost (organic N fertilizer) is shown in Table 3.

Table 2: The experimental design.

Treatments number	Treatments		
	Irrigation systems	Organic and/or inorganic nitrogen fertilizers	Biofertilizers
1	Surfaceirr igation	100% inorganic nitrogen	0.0
2			Yeast (3.0 g/l)
3			Nitrobein (3.0 g/l)
4		75% inorganic nitrogen + 25% organic	0.0
5			Yeast (3.0 g/l)
6			Nitrobein (3.0 g/l)
7		50% inorganic nitrogen + 50% organic	0.0
8			Yeast (3.0 g/l)
9			Nitrobein (3.0 g/l)
10		25% inorganic nitrogen + 75% organic	0.0
11			Yeast (3.0 g/l)
12			Nitrobein (3.0 g/l)
13		100% organic nitrogen	0.0
14			Yeast (3.0 g/l)
15			Nitrobein (3.0 g/l)
16	Dripirrigation	100% inorganic nitrogen	0.0
17			Yeast (3.0 g/l)
18			Nitrobein (3.0 g/l)
19		75% inorganic nitrogen + 25% organic	0.0
20			Yeast (3.0 g/l)
21			Nitrobein (3.0 g/l)
22		50% inorganic nitrogen + 50% organic	0.0
23			Yeast (3.0 g/l)
24			Nitrobein (3.0 g/l)
25		25% inorganic nitrogen + 75% organic	0.0
26			Yeast (3.0 g/l)
27			Nitrobein (3.0 g/l)
28		100% organic nitrogen	0.0
29			Yeast (3.0 g/l)
30			Nitrobein (3.0 g/l)

The respected rates of the compost were applied to the soil one week before the marjoram seedling. The compost rates were 0.0, 1.661, 3.322, 4.983, 6.645 ton/feddan. The compost rates were spread on the soil surface and incorporated in the depth of 0.0-30 cm during the soil preparation.

The phosphorus fertilization was applied to the soil of all plots during the soil preparation in the form of calcium superphosphate (15.5% P2O5) at the standard recommended rate of 100 kg calcium superphosphate/feddan.

Table 3: The chemical analysis of the compost.

Chemical composition	Value
pH*	7.88
EC (dS m^{-1})**	4.90
Organic carbon (%)	24.33
Organic matter (%)	41.95
Total nitrogen (%)	1.24
Total phosphorus (%)	0.47
Total potassium (%)	0.96
C/N ratio	19.62

*pH was measured in a soil-water suspension (Ratio 1:2.5).
**EC= Electrical conductivity was measured in a soil-water extract (Ratio 1:5).

Marjoram (*Marjorana hortensis* L.) variety sweet marjoram were sown at the rate of 250 g/feddan during the first week of Augast, 2012 and transplanted (70.0 days old) to the experimental field during the last week of November 2012, where two seedling plants were seedling in the two sides of the ridge. The ridges spacing was 70 cm apart, and 20 cm distance between seedlings giving a plant density of 60000 plants/feddan.

The respected levels of the biofertilizers as follows:

1- 0.0 g/l biofertilizers (without).
2- 3.0 g/l yeast.
3- 3.0 g/l nitrobein (*Azotobacter spp, Azosperllium spp*). Nitrobein is the commercial name of nitrogen fixing bacteria containing *Azotobacter spp. (Azotobacter chroococcum)* and *Azosperllium spp. (Azosperllium lipoferum)*.

The biofertilizers were applied as a solution as follows:

1. The seedlings of marjoram were inoculated with the yeast solution or nitrobein solution before transplant to experimental field 12-24 hour.
2. The biofertilizers treatment were sprayed on the soil beside the roots after each cuts.

The inorganic nitrogen fertilizer was applied to the soil as ammonium sulphate (20.6% N) at the recommended rate of 82.4 kg N/feddan at four equal doses for each cut.

The recommended level of the potassium fertilizer was applied to the soil as potassium sulphate (48% K2O). The potassium fertilization level was 50 kg potassium sulphate/feddan which gives 24 kg K2O/feddan. The potassium sulfate was divided into three equal doses, the first dose was applied one month after seedling, the second dose was applied after the 1st cut, and the third dose was applied after the 2nd cut.

The marjoram plants were cut at maturity during three times (the first week of May 2012, the fourth week of July 2012, and the first week of November 2012, respectively). At the time of the harvest, a representative sample of the marjoram plants was collected and randomly chosen within the plot. Then, this representative sample of the marjoram plants was used to record herb dry weight (ton/feddan), oil yield (kg/feddan). After recording the yield at the first, second, and third cuts, a representative sample of the marjoram plants was taken individually from the above mentioned representative sample of the marjoram plants. The plant materials were dried in the oven at 65 °C, ground in a plant mill and sieved to pass through a 0.5 mm screen. The dried and sieved plant materials were mixed thoroughly and a subsample was taken digested and analyzed for the total nitrogen, total phosphorus, and total potassium as described by Chapman and Pratt (1961).

Quantitative analysis of marjoram essential oil

Quantitative of marjoram essential oil obtained from different treatments were achieved by hydro-distillation during first, second, and third cuts. Distillation of 100 g fresh herb was continued for 2.5-3.0 hour after water boiling till no further increase in the oil was observed as described by British Pharmacopeia (1963), and then calculated as oil yield/plant by multiplying oil percent by plant fresh weight (g).

Statistical analysis

The obtained data were subjected to the analysis of variance using the least significant difference test (L.S.D.) at 5% level of probability according to the procedure outlined by Steele and Torrie (1980). The L.S.D. was used to compare the various treatments means.

RESULTS AND DISCUSSSIONS

The obtained results of the current study will be presented and discussed under the following main three subjects:

1. Herb dry weight (ton/feddan)

The effect of inorganic and organic nitrogen fertilization as well as biofertilizers under the two irrigation systems on the herb dry weight (ton/feddan) of marjoram at the first, second, and third cut are presented in Table 4. In general, the data clearly showed that the herb dry weight of the 1st was higher than 2nd and 3rd cuts. It can be noticed from Table 4 that the herb dry weight (ton/feddan) of marjoram plant was increased due to the drip irrigation compared to as the surface irrigation. The increase in the herb dry weight (ton/feddan) was significant (p =0.05) between surface irrigation and drip irrigation. This might be due to water stress during the critical growth period, coupled with aeration problem in first few days immediately after irrigation. Another reason to get low yield by surface irrigation may be due to less availability of nutrients for crop growth due to leaching with high weed infestation between the crops (Pattanaik *et al*., 2003). These results are in agreement with those obtained by Sankar *et al*. (2008) who reported that in drip irrigation system; water is applied at a low rate for a longer period at frequent intervals near the plant root zone through lower pressure delivery system, which increases the availability of nutrients near the root zone with a reduction in leaching losses. More nutrient availability, especially near the root zone might have increased the translocation of photosynthetes to storage organ of capsicum resulting in an increased weight of capsicum.

With regared to nitrogen fertilization, the treatment of 100% inorganic (N) produced the highest herb dry weight in the 1^{st} , and 2^{nd} cuts, wheras, the treatment of 75% inorganic (N)+ 25% organic (N) yielded highest herb dry weight in the 3^{rd} cut when compared with the other treatments. These results may be due to the organic fertilizers in comparison to chemical fertilizers, the farmer have low nutrient content and are slow release but they are as effective as chemical fertilizers over longer periods of use (Naguib, 2011). In addition, Hadipour *et a*l. (2013) mentioned that nitrogen is one of the very effective elements in increasing the phytochemical and agronomical yield of medicinal plants, accordingly it is necessary to examine the effect of nitrogen on essential oil and dry matter production of lavender. These results harmonically agree with those reported by Hamza and Abd-Elhady (2010).

Concerning the biofertilizers, the results cleraly revealed that the yeast and nitrobein increased the herb dry weight (ton/feddan) of marjoram plant compared to that of control treatmeant in the all cuts. The increase in the herb dry weight (ton/feddan) of marjoram plant was significant in the all cuts. It is obvious to notice that, the use of nitrobein was better than the use of yeast and contributed in high significant herb dry weight (ton/feddan). These results coincide with those reported by Vande Broek (1999) who pointed out that the application of bio-fertilizers *Azospirillum* and *Azotobacter* in the medicinal plant of *Salvia officinalis* reported to increase the plant height ,shoot dry and wet weights.

The interaction effect between the irrigation systems and nitrogen fertilization, between the irrigation systems and biofertilizers, and between nitrogen fertilization and biofertilizers on the herb dry weight (ton/feddan) of marjoram plant was significant in the all cuts. Also, the interaction effect between the irrigation systems, nitrogen fertilization, and biofertilizers on the herb dry weight (ton/feddan) of marjoram plant was significant in the all cuts.

Table 4: Effect of inorganic and organic nitrogen fertilization as well as biofertilizers under the two irrigation systems on the herb dry weight (ton/feddan) and oil yield (kg/feddan) of marjoram at the 1st , 2nd , and 3rd cuts as well as total N, P, and K uptake (kg/feddan) by the marjoram leaves.

Treatments number	Irrigation systems	Inorganic and/or organic N	Biofertilizers	Herb dry weight (kg/feddan)			Oil yield (kg/feddan)			Total uptake (kg/feddan)		
				1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	N	P	K
1	Surface irrigation	100% inorganic N	0.0	0.770	0.560	0.433	8.482	6.375	4.965	35.820	3.562	27.665
2			Yeast	0.780	0.572	0.435	8.178	6.178	4.750	36.107	3.735	27.810
3			Nitrobein	0.793	0.575	0.445	8.240	6.540	4.960	37.075	3.617	28.065
4		75% inorg. N+ 25% org. N	0.0	0.707	0.470	0.400	9.493	6.462	4.685	32.165	3.208	24.530
5			Yeast	0.820	0.567	0.455	11.348	7.420	5.840	37.447	3.985	28.607
6			Nitrobein	0.828	0.570	0.460	11.483	7.525	5.845	37.580	3.823	28.775
7		50% inorg. N+ 50% org. N	0.0	0.680	0.480	0.370	10.938	7.025	5.160	31.065	3.190	23.702
8			Yeast	0.748	0.560	0.450	12.298	8.447	6.018	36.045	3.700	27.362
9			Nitrobein	0.842	0.600	0.485	12.990	8.805	6.530	39.207	3.872	29.843
10		25% inorg. N+ 75% org. N	0.0	0.700	0.460	0.370	12.005	7.947	5.530	30.818	3.150	23.598
11			Yeast	0.743	0.530	0.420	13.295	8.842	5.928	34.210	3.400	26.173
12			Nitrobein	0.787	0.553	0.470	14.503	9.237	6.697	37.177	3.723	28.060
13		100% organic N	0.0	0.623	0.420	0.350	12.895	7.640	5.415	28.495	3.100	21.627
14			Yeast	0.690	0.480	0.400	14.167	8.045	6.402	31.550	3.205	24.290
15			Nitrobein	0.790	0.550	0.440	15.828	9.545	6.572	35.985	3.647	27.740
16	Drip irrigation	100% inorganic N	0.0	1.108	0.733	0.572	10.150	7.603	6.170	48.552	4.992	37.057
17			Yeast	1.100	0.740	0.582	10.320	7.723	6.147	49.092	4.905	37.405
18			Nitrobein	1.110	0.743	0.580	10.212	7.893	6.127	49.422	5.043	37.503
19		75% inorg. N+ 25% org.	0.0	0.940	0.640	0.520	11.790	8.000	5.925	42.485	4.260	32.465
20			Yeast	1.130	0.790	0.620	13.953	9.398	7.155	51.507	5.255	39.240
21			Nitrobein	1.135	0.820	0.627	14.233	10.045	7.880	52.805	5.360	37.507

	N										
22	50%	0.0	0.800	0.570	0.440	12.705	8.507	5.685	37.097	3.760	28.090
23	inorg. N+	Yeast	1.000	0.690	0.560	15.005	10.172	7.125	45.945	4.495	34.785
24	50% org. N	Nitrobein	1.120	0.790	0.640	17.417	11.528	8.008	51.852	5.328	39.672
25	25%	0.0	0.785	0.563	0.470	13.600	9.063	6.317	37.140	3.775	28.395
26	inorg. N+	Yeast	0.870	0.610	0.490	14.610	9.395	6.917	40.238	3.955	30.470
27	75% org. N	Nitrobein	1.020	0.740	0.610	18.692	11.560	8.430	48.595	4.813	37.000
28	100%	0.0	0.730	0.500	0.440	14.695	8.780	6.293	34.102	3.460	26.080
29	organic N	Yeast	0.850	0.530	0.450	15.797	9.370	6.702	37.052	3.690	27.970
30		Nitrobein	0.960	0.700	0.570	19.750	12.183	8.158	45.825	4.525	34.872
Mean of irrigation systems (A)	Surface irrigation		0.753	0.530	0.425	11.743	7.736	5.686	34.716	3.528	26.523
	Drip irrigation		0.977	0.677	0.545	14.195	9.415	6.869	44.781	4.508	33.901
Mean of N fertilization (B)	100% Mineral (N)		0.943	0.654	0.508	9.264	7.052	5.520	42.678	4.309	32.584
	75% Inorganic (N) + 25% Organic (N)		0.927	0.643	0.514	12.050	8.142	6.222	42.332	4.315	31.854
	50% Inorganic (N) + 50% Organic (N)		0.865	0.615	0.491	13.559	9.081	6.421	40.202	4.058	30.576
	25% Inorganic (N) + 75% Organic (N)		0.817	0.576	0.472	14.451	9.341	6.637	38.030	3.803	28.949
	100% Organic (N)		0.774	0.530	0.442	15.522	9.260	6.590	35.502	3.605	27.097
Mean of biofertilizers (C)	0.0		0.784	0.539	0.436	11.675	7.740	5.614	35.774	3.646	27.321
	Yeast		0.873	0.607	0.486	12.897	8.499	6.298	39.919	4.032	30.411
	Nitrobein		0.938	0.664	0.533	14.335	9.486	6.921	43.552	4.375	32.904
	L. S. D. at 5% level:										
	Irrigation systems (A)		0.009	0.002	0.006	0.257	0.213	0.306	0.392	0.063	0.576
	Nitrogen fertilization (B)		0.008	0.006	0.006	0.379	0.340	0.301	0.238	0.128	0.564
	Biofertilizers (C)		0.009	0.007	0.007	0.422	0.304	0.362	0.149	0.078	0.451
	(A) X (B)		0.011	0.008	0.008	N. S.	N. S.	N. S.	0.337	0.181	0.797
	(A) X (C)		0.012	0.010	0.010	0.597	0.430	N. S.	0.211	0.111	0.638
	(B) X (C)		0.020	0.016	0.017	0.944	0.680	N. S.	0.333	0.175	1.008
	(A) X (B) X (C)		0.027	0.023	0.023	N. S.	N. S.	N. S.	0.471	N. S.	1.425

In general, the highest values of the herb dry weight (ton/feddan) of marjoram (1.135 and 0.820 ton/feddan) were obtained when the marjoram plant treated with 75% inorganic + 25% organic and nitrobein under drip irrigation in the all cuts, respectively. In the 3rd cut, the highest value of the herb dry weight (ton/feddan) of marjoram (0.640 ton/feddan) was obtained when the marjoram plants treated with 50% inorganic + 50% organic and nitrobein under drip irrigation. However, the lowest values of the herb dry weight of marjoram plant (0.623, 0.420, and 0.350 ton/feddan) were obtained when the marjoram plants were treated with 100% organic and without biofertilizers under surface irrigation in the all cuts, respectively.

2. Oil yield (kg/feddan)

The effect of inorganic and organic nitrogen fertilization as well as biofertilizers under the two irrigation systems on the oil yield (kg/feddan) of marjoram at the first, second, and third cut are illustrated in Table 4. It is clearly to notice that the 1st cut yielded higher oil yield than the two other cuts. The oil yield (kg/feddan) values of the marjoram at the all cuts were significantly increased by using the drip irrigation system compared to using the surface irrigation system. The increase in the oil yield (kg/feddan) values of the marjoram at the all cuts under drip irrigation system might be due to unfavourable moisture regime (moisture stress s or excess moisture) in the soil through surface irrigation and competition of weeds for nutrients (Pattanaik *et al*., 2003; Agrawal and Agrawal, 2005). The increased growth may be attributed to supplying water and nutrients in adequate proportion, which resulted in triggering the production of plant growth hormone, viz. indole acetic acid (IAA) and higher number of leaves throughout the cropping period (Sankar *et al*., 2008).

Adding of 100% organic (N) in the 1st cut and 25% inorganic (N) + 75% organic (N) in the 2nd and 3rd cuts of marjoram plants recorded a significant higher oil yield (kg/feddan) than that of the treatment with 75% inorganic + 25% organic, 50% inorganic + 50% organic, and 100% inorganic (N). The increase in oil yield (kg/feddan) as a result of applying 100% organic (N) in the 1st cut and 25% inorganic (N) + 75% organic (N) in the 2nd and 3rd cuts of marjoram plants could be attributed to either increase in vegetative growth or changes in leaf oil gland population and monoterpenes biosynthesis (Gharib *et al*., 2008). These results are agree with those reported by Hamza and Abd-Elhady (2010) who revealed that the values of volatile oil percentage in herb in 1st and 2nd cuts of marjoram plants were recorded with organic fertilization treatments.

The biofertilizers at the yeast and nitrobein increased the oil yield (kg/feddan) of marjoram plant compared to that of control treatmeant in the all cuts. The increase in the oil yield (kg/feddan) of marjoram plant was significant in the all cuts. It could be observed that the use of nitrobein was better than the use of yeast and contributed in production of more significant a mount of the oil (kg/feddan). Banchio *et al.* (2008) who reported that, few studies have attempted to elucidate the relative qualitative contributions of rhizobacteria formation secondary compound in essential oil for aromatic crops. Their results suggested that inoculation with *P. fluorescens* and *Bradyrhizobium sp*. can significantly increase oil concentration of *Origanum marjorana L.* (El-Ghandour *et al*., 2009).

The interaction effect between the irrigation systems and nitrogen fertilization was significant in the all cuts on the oil yield (kg/feddan) of marjoram plant. The interaction effect between the irrigation systems and biofertilizers, and between nitrogen fertilization and biofertilizers on the oil yield (kg/feddan) of marjoram plants was significant in the 1^{st} cut and 2^{nd} cut, while, in the 3^{rd} cut it was not significant. Also, the interaction effect between the irrigation systems, nitrogen fertilization, and biofertilizers on the oil yield (kg/feddan) of marjoram plants was not significant in the all cuts.

The highest value of the oil yield (kg/feddan) of marjoram (19.750 kg/feddan) was obtained when the marjoram plants treated with 100% organic and nitrobein under drip irrigation in the 1^{st} cut. However, the lowest value of the oil yield (kg/feddan) of marjoram plant (6.178 kg/feddan) was obtained when the marjoram plants were treated with 100% inorganic and yeast under surface irrigation.

3. Total N P K uptake (kg/feddan)

The data illustrated in Table 4 show the effect of inorganic and organic nitrogen fertilization as well as biofertilizers under the two irrigation systems on the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves at the first, second, and third cuts. It appears from data that the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves were significantly increased under the drip irrigation compared to that of the surface irrigation. This could be attributed to the advantages of drip irrigation for: a) fertilizer and nutrient loss is minimized due to localized application and reduced leaching. b) water application efficiency is high. c) moisture within the root zone can be maintained at field capacity. d) weed growth is lessened. e) water distribution is highly uniform, controlled by output of each nozzle (Wikipedia, 2014).

Regarding to the nitrogen fertilization, applying 100% inorganic (N) gave the total nitrogen and potassium uptake significantly higher than that of the treatment with 75% inorganic (N) + 25% organic (N), 50% inorganic (N) + 50% organic (N), 25% inorganic (N) + 75% organic (N), and 100% organic (N) in the 1^{st} and 3^{rd} cuts. While, in the 2^{nd} cut the applying of 75% inorganic (N) + 25% organic (N) gave the highest values of the total phosphorus uptake by marjoram leaves. The obtained results agree harmonically with those reported by Thompsond and Troch (1975) who pointed out that supplying the plants with adequate quantities of N at right time tends to increase cell number and cell size with an overall increase in the vegetative growth production. Also, Garg and Bahl (2008) indicated that organic materials are known to increase P availability and enhance efficient use of applied P fertilizer.

As for the biofertilizers, the yeast and nitrobein increased the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves compared to those of control treatmeant in all cuts. The increases in the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves were significant. The use of nitrobein was better than the use of yeast and was gave the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves. These results are consistent with those reported by Belimov *et al*. (1995) who reported that, the inoculation with bacterial mixtures provided a more nutrition for the plants and the improvement in root uptake of both nitrogen and phosphorus as a balance result of mechanism of interaction between nitrogen fixing and phosphate solubilizing bacteria. Also, Hegde *et al*. (1999) stated that the use of N-fxing bacteria (nitrobein) as a biofertilizer product containing nitrogen fixing bacteria, e.g. Azotobacter and Azospirillium was found to have not only the ability to fix nitrogen but also to release certain phytohormones of gibberellins and indolic nature which could enhance plant growth absorption of nutrients and so on photosynthesis process.

The interaction effect between the irrigation systems, nitrogen fertilization, and biofertilizers on the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves was significant in the 1st and 3rd cuts. While, in the 2nd cut the interaction effect between the irrigation systems, nitrogen fertilization, and biofertilizers on the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves was not significant.

The highest values of the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves (52.805, 5.360, and 39.672 kg/feddan, respectively) were obtained when the marjoram plant treated with 75% inorganic + 25% organic and nitrobein under drip irrigation in the 1st cut and 2nd cut, and 3rd cut respectively. However, the lowest values of the total nitrogen, phosphorus, and potassium uptake (kg/feddan) by the marjoram leaves (28.495, 3.100, and 21.627 kg/feddan, respectively) were obtained when the marjoram plants were treated with 100% organic and without biofertilizers under surface irrigation in the 1st cut and 2nd cut, and 3rd cut, respectively.

CONCLUSION

Generally; it can be concluded that, applying 75% inorganic (N) +

25% organic (N) with nitrobein under drip irrigation, in most cases, gave the best quality and quantity yield of marjoram (*Marjorana hortensis* L.) cultivated in the newly reclaimed soils under conditions of El-Minia Governorate, Egypt.

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الملخص العربي

تأثير بعض المعاملات الزراعية علي انتاجية البردقوش وخصوبة التربة تحت ظروف الاراضي المستصلحة حديثا

1- المحصول وامتصاص بعض العناصر الغذائية

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أجريت هذة الدراسة على نطاق حقلى خلال موسم النمو 2012–2013 لزراعة محصول البردقوش فى منطقة استصلاح الأراضى الجديدة بمحافظة المنيا، وذلك لدراسة تأثير اضافة الأسمدة النيتروجينية الغيرعضوية والعضوية وكذلك الأسمدة الحيوية تحت نظامى رى (سطحى ، تنقيط) وتشتمل التجربة على نظامى رى وخمس مخاليط من الأسمدة المعدنية والعضوية (100% نيتروجين غير عضوي ، 75% نيتروجين غير عضوي + 25% نيتروجين عضوي ، 50% نيتروجين غير عضوي + 50% نيتروجين عضوي ، 25% نيتروجين غير عضوي + 75% نيتروجين عضوي ، 100% نيتروجين عضوي) وثلاث معالجات من التسميد الحيوى (بدون تسميد حيوي ، خميرة ، نتروبين) باستخدام 4 مكررات.أعطت الحشة الأولى أعلى القيم للوزن الجاف ولمحصول الزيت بالمقارنة بالحشة الثانية والثالثة. ادى استخدام الرى بالتنقيط الى زيادة معنوية في قيم الوزن الجاف ومحصول الزيت مقارنة بالرى السطحى. أدت المعاملات 100% نيتروجين غير عضوي ،وكذلك 75% نيتروجين غير عضوي +25% نيتروجين عضوى الى زيادة معنوية في الوزن الجاف للعشب في الحشات الثلاث ، في الجانب الاخر ادت المعاملات 100% نيتروجين عضوى و 25% نيتروجين غير عضوي + 75% نيتروجين عضوي الى زيادة معنوية فى محصول الزيت فى الحشات الثلاثة. تفوق النتروبين على الخميرة فى محصول الوزن الجاف ومحصول الزيت. ادت المعاملات 100% نيتروجين غير عضوي وكذلك 75% نيتروجين غير عضوي +25% نيتروجين عضوى مع استخدام النتروبين الى تحسن فى امتصاص كل من النيتروجين والفوسفور والبوتاسيوم لنبات البردقوش تحت نظام الرى بالتنقيط. وعموما فان استخدام 75% نيتروجين غير عضوي + 25% نيتروجين عضوي مع استخدام النتروبين كسماد حيوي اعطي افضل قيم لمحصول البردقوش ومحصول الزيت وامتصاص العناصر الغذائية (نيتروجين وفوسفور وبوتاسيوم) تحت نظام الري بالتنقيط في الاراضي المستصلحة حديثا بمحافظة المنيا.