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Response of some Citrus Rootstock Seedlings to Fertilization by the Aqueous Extract of some Irradiated Animal Manures.

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ABSTRACT

A pot experiment was carried out during two consecutive seasons i.e. 2001&2002 on two citrus rootstocks namely Sour orange and Volkamer lemon seedlings two-month-old planted in a sandy soil under greenhouse to study the feasibility of using the aqueous extract of some animal manures i.e. poultry, sheep and cattle treated by gamma irradiation at 10 kGay to keep the manure free from pathogenic organisms, pests and weed seeds and as a natural source of nutrients instead of mineral fertilizers, and it's effect on growth and leaf nutrients content of seedlings.

Generally, results showed that all the tested treatments enhanced most of growth parameters such as seedling height, stem diameter, root length, number of leaves/seedling, number of roots/seedling, and dry weight for both of stem, leaves, root and total dry weight/plant. Moreover, such treatments improved leaf nutrient content of both of Sour orange and Volkamer lemon seedlings. Meanwhile, seedlings fertilized by the aqueous extract of poultry manure achieved the highest values of growth parameters and leaf nutrients content as well as mineral fertilizer followed by those treated by the aqueous extract of both sheep and cattle manures.

Key Words: gamma Radiation / Organic Nutrition / Aqueous Extract of some Animal Manure / Citrus seedlings.

INTRODUCTION

The vitality of citrus plants is influenced by a large number of factors, as it is well known that the maximum growth needs an optimum availability of all macro-and micro-nutrients. Animal wastes are considering an enriched source of the most of essential nutrient elements for growth and development of plants. However a few part of animal waste is used as a fertilizer, while the remainder accumulates yearly causing an increase in the probability of environmental pollution, and the need to recycling as a fertilizer becomes urgent nowadays.

A technology of radiation processing can be used as integral part in safe recycling animal waste. Also it can be used to reduce microbial load in contamination materials such as animal wastes and sewage sludge, also it can be used to destroy toxic organic materials, pests and weed seeds (1&2)

Many investigators reported that irradiated dried animal manure with doses up to 10 kGy showed a marked reduction in total bacterial count, mold and yeast (3).

Recently, there has been emphasis on the use of animal wastes as a natural source of most nutrients in many fruit orchards .Also, one can apply the aqueous extract of irradiated dry animal manure under drip irrigation system to provide the plants with completely nutrient solution free of pathogenic , pests and weed seeds (4).

The objective of the present work was to study the feasibility of fertilizing some citrus rootstocks seedlings, namely sour orange and volkamer lemon by using the aqueous extract of irradiated dry animal manures i.e. poultry, sheep and cattle and studying its effect on plant growth and leaf nutrient content.

MATERIALS AND METHODS

This investigation was conducted during two consecutive seasons 2001 & 2002 at the nursery of Plant Research Department, Nuclear Research Center, Inshas,, Egypt.Two-month old of both

sour orange and volkamer lemon seedlings were transplanted individually each in black plastic bag (pot) filled with 10 Kg of sandy soil, the soil was characterized with : 8.11 pH, 0.08 % organic matter, 0.68 EC and 4.2 % $CaCo_3$.

Twenty transplants were adopted for both rootstocks, where the seedlings fertilized with one of the following nutrient solutions:

1-Mineral fertilizer solution using "Krystalon" fertilizer (19-19-19) 2 gm / L. per pot twice weekly.

2-Aqueous extract of dry poultry manure irradiated with 10 kGy of gamma ray, resulted by soaking 5 gm of manure in one liter of water for 48 hour / pot twice weekly.

3-Aqueous extract of dry sheep manure irradiated with10 kGy of gamma ray , resulted by soaking 5 gm of manure in one liter of water for 48 hour / pot twice weekly.

4-Aqueous extract of dry cattle manure irradiated with 10 kGy of gamma ray, resulted by soaking 10 gm of manure in one liter of water for 48 hour / pot twice weekly.

The electrical conductivity (EC) of the nutrient solutions were maintained between 2-3 mmhos Cm^{-1}, also nutrients content analysis for the aqueous extracts of irradiated dry animal manures i.e. poultry, sheep and cattle are shown in Table (1).

Table (1):Water soluble nutrients of some irradiated animal manures after soaking in water for 48 in ppm.

Manures	N	P	K	Ca	Mg	Zn	Mn	Fe
Poultry	81	24	273	68	21	2.6	.59	2.31
Sheep	72	18	124	42	31	2.7	.32	2.26
cattle	36	15	87	25	47	1.2	.26	1.54

The pots were arranged in a completely randomized design and each treatment was represented by one pot (plant). The effect of the above different nutrient solutions on plant growth and leaf nutrient content of sour orange and volkamer lemon seedlings was handled as follow:

At the end of October of both season of study, seedlings were gently removed from the soil, washed carefully with tap water then distilled water, where the following parameters were determined: plant height (cm), stem diameter (cm) at 5 cm above the soil surface, root length (cm), number of leaves per seedling, number of roots per seedling, dry weight for both of leaves, stem and root were determined then recorded and total seedling dry weight was estimated.

Dry leaves were ground, digested and prepared for analysis using the method described by (5) for determining the deferent nutrients. The obtain data were subjected to analysis of variance according to (6) and Duncan's method was used to differentiate means.

RESUITS AND DISCUSSION

I-Growth Parameters:

Data presented in Table (2) show the effect of fertilization by the aqueous extract for some different sources of irradiated animal manures (organic fertilizer) namely; poultry, sheep and cattle manure in comparison with the mineral solution on growth parameters of Sour orange and Volkamer lemon seedlings rootstocks in seasons 2001&2002.

Table (2) . Effect of fertilization by the aqueous extract of irradiated poultry, sheep and cattle manure on some growth parameters of Sour orange and Volkamer lemon seedlings (2001&2002).

Treatments	Seedling height (cm)		Stem diameter (cm		Root length (cm)		No. of leaves per Seedling		No. of Roots per Seedling	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
					Sour orange rootstock					
Mineral solution	86.0 a	95.7 a	0.84 b	0.86 a	16.38 a	16.33a	99 a	98 b	1.89 a	1.96 a
*A.E. of irradiated poultry manure	84.8 a	74.3 b	0.88 a	0.84 a	16.03 a	15.75a	93 b	108 a	1.91 a	2.01 a
*A.E. of irradiated sheep manure	65.5 b	56.0 c	0.78 c	0.71 b	15.65 a	15.55a	74 c	87 c	1.89 a	1.98 a
*A.E. of irradiated cattle manure	51.5 c	47.7 d	0.66 d	0.61 c	15.25 a	15.25a	54 d	74 d	1.87 a	1.98 a
Mineral solution					Volkamer lemon rootstock					
Mineral solution	78.0 a	72.0 a	0.89 b	0.88 b	17.92 a	17.95a	96 b	92 a	2.65 a	2.72 a
*A.E. of irradiated poultry manure	73 .0 b	71.5 a	0.98 a	0.99 a	18.55 a	18.6 a	104 a	95 a	2.62 ab	2.62 c
*A.E. of irradiated sheep manure	61.3 c	57.5 b	0.73 c	0.87 b	17.98 a	18.25a	95 c	82 b	2.58 ab	2.68ab
*A.E. of irradiated cattle manure	41.3 d	39..0 c	0.60 d	0.76 c	17.55 a	17.95a	76 d	65 c	2.53 c	2.63bc

***A.E. = the aqueous extract of animal manure (poultry, sheep and cattle).**
Means having the same letter(s) in each column are not significantly differ at 5 % level.

1-Seedling height:

It's obvious that in both seasons of study, all the tested treatments caused significant differences in seedlings height in both Sour orange and Volkamer lemon seedlings, whereas the tallest seedlings were observed with those fertilized with mineral solution and poultry manure, respectively. On the contrary, sheep and cattle manure treatments induced the least effect in this aspect.

2-Stem diameter:

In the first season of study Sour orange seedlings fertilized with poultry manure revealed a significant increase in stem diameter compared with mineral solution and other treatments. While mineral solution in the second season exerted the highest significant value for stem diameter compared with other treatments which arranged in a descending order; as poultry, sheep and cattle, respectively. On the other side, in both seasons fertilization of Volkamer lemon seedlings with the aqueous extract of poultry manure gave the largest significant value for stem diameter compared with the other treatments which arranged in a descending order; as mineral solution, sheep and cattle, respectively.

3-Root length:

Data recorded for this parameter, revealed that all the tested treatments and both rootstocks in the two seasons of study didn't exert any significant differences between them.

4-Number of leaves/seedling:

In first season of study all fertilization treatments of Sour orange seedlings resulted in a significant difference in number of leaves/plant, whereas mineral solution exerted the highest significant value, followed by poultry, sheep and cattle treatment, respectively. While in the second season, poultry treatment induced the highest value followed by mineral solution, sheep and cattle, respectively. On the other side, in both seasons Volkamer lemon seedlings fertilized by aqueous extract of poultry manure gave the highest significant value of number of leaves/plant compared with the other treatments which revealed significant differences in descending order; as mineral solution , sheep and cattle, respectively.

5-Number of roots / seedling:

Data in both seasons 2001&2002 show that, different treatments for fertilization of Sour orange seedlings didn't affect significantly the number of roots/seedling. While in Volkamer lemon seedlings, mineral solution induced the highest number of roots/seedling compared with those produced by using the aqueous extract of poultry, sheep, and cattle manure in both seasons; moreover differences between them were too close to reach the significant level.

II-Seedlings Dry Weight:

It is clear from table (3) in both seasons that dry weight parameters of Sour orange seedlings (leaves, stem, root and total dry weight) in both mineral solution and aqueous extract of poultry manure were higher significantly than other treatments, which were not differ significantly in this aspect . Also root dry weight for sheep manure treatment didn't differ significantly with mineral solution and poultry treatments in the first season only. While all parameters of dry weight for both sheep and cattle manure treatments gave the lowest significant values in this concern.

Concerning Volkamer seedlings treatments, it is obvious that stem dry weight of mineral solution treatment in the first season gave a higher significant value than other treatments followed by poultry, sheep and cattle manure treatments in a descending order, respectively. While stem dry weight for mineral solution, poultry and sheep manure treatments in the second season didn't differ significantly, also cattle manure treatment in both seasons gave the lowest significant value in this aspect.

Table (3) . Effect of fertilization by the aqueous extract of irradiated poultry, sheep and cattle manure on dry weight parameters of Sour orange and Volkamer lemon seedlings (2001&2002).

Treatments	Stem dry weight (gm)		Leaves dry weight (gm)		Root dry weight (gm)		Total dry weight (gm)	
	2001	2002	2001	2002	2001	2002	2001	2002
Sour orange rootstock								
Nutrient solution	4.68 a	4.65 a	4.66 a	4.66 a	4.85 a	4.62 a	14.19 a	13.78 a
*A.E. of irradiated poultry manure	4.45 ab	4.66 a	4.88 a	4.88 a	4.58 a	4.65 a	13.91 a	13.96 a
*A.E. of irradiated sheep manure	4.21 b	4.42 b	4.26 b	4.26 b	4.54 a	4.21 b	12.44 b	12.65 b
*A.E. of irradiated cattle manure	3.45 c	3.61 b	3.24 a	3.24 a	3.53 b	3.62 c	10.18 c	10.68 c
Volkamer lemon rootstock								
Mineral solution	4.65 a	4.7 a	4.36 b	4.40 b	4.80 a	4.80 a	13.77 a	13.94 a
*A.E. of irradiated poultry manure	4.25 b	4.45 a	4.76 a	4.77 a	4.82 a	4.82 a	13.70 a	14.05 a
*A.E. of irradiated sheep manure	4.08 b	4.36 a	4.35 b	4.39 b	4.23 b	4.23 b	12.53 b	12.95 b
*A.E. of irradiated cattle manure	3.16 c	3.22 b	2.95 c	3.41 c	2.96 c	2.96 c	8.78 a	9.71 c

***A.E. = the aqueous extract of animal manure (poultry, sheep and cattle).**

Means having the same letter(s) in each column are not significantly differ at 5 % level.

Regarding Leaves dry weight in both seasons, poultry manure treatment produced the highest significant value compared with the other treatments. However, the differences between both mineral solution and sheep manure treatments did differ significantly, while cattle manure treatment exerted the lowest significant value in this aspect. Concerning, root and total dry weight of Volkamer lemon seedlings it is clear in both seasons that, mineral and poultry manure treatments give the highest significant values compared with the treatments of sheep and cattle manure, also cattle manure treatment gave the lowest significant value of root and total dry weight.

These results are in agreement with those obtained by (7) on Satsuma mandarin, (8) on Baladi mandarin, (9&10) on Washington naval orange trees, who reported that apply most animal manures in citrus orchards improved trees growth parameters .Generally, poultry manure proved to be the superior organic manure source .

III- Leaf Mineral Content:

Data presented in table (4&5) show the effect of fertilization with four different nutrient solutions; mineral solution, aqueous extract of poultry, sheep and cattle manure, respectively, on leaf mineral content of Sour orange and Volkamer lemon seedlings in seasons 2001&2002.

1- leaf-N content:

In both seasons of study and both sour orange and Volkamer lemon seedlings , all the tested treatments caused a marked increase in leaf-N content. Moreover, leaf-N content of mineral and poultry manure treatments were not differ significantly and gave the highest significant values compared with sheep and cattle manure treatments.

2- leaf-P content:

In both Sour orange and Volkamer lemon seedlings in seasons 2001&2002, mineral and poultry manure treatments gave the highest significant value of leaf-P content followed by sheep and cattle manure treatments which achieved the lowest significant value of leaf-P content in a descending order.

3-Leaf-K content:

Concerning the effect of different fertilization treatments on leaf-K content in Sour orange seedlings, it is clear that the values of leaf-K content were significantly arranged in a descending order as; poultry, mineral, sheep and cattle manure in both seasons of study. Regarding, leaf-K content of Volkamer lemon seedlings in the two seasons, poultry manure treatment exerts the highest significant value, while cattle manure treatment showed the lowest significant value.

4- Leaf-Ca content:

Generally, in both seasons 2001&2002 and both rootstocks under study, poultry manure treatment caused a high significant increase in leaf-Ca content compared with sheep and cattle manure treatments, but they didn't differ significantly with the mineral treatment. Also, there was no

significant difference in leaf-Ca content in both of sheep manure and mineral treatment. On the other side cattle manure treatment exerted the lowest significant value in this aspect.

5- Leaf-Mg content:

In both seasons of study in Sour orange seedlings, mineral treatment significantly increased leaf-Mg content as well as poultry manure treatment in the second season compared with other treatments, which arranged significantly in a descending order as; poultry, sheep and cattle manure treatments.

In regard to Volkamer lemon seedlings in both seasons, poultry manure treatment achieved the highest significant value of leaf-Mg content as well as mineral treatment in the first season compared with other treatments which arranged significantly in a descending order as; mineral, sheep and cattle manure treatments, respectively.

6- Leaf- Zn content:

As show in Table (5), fertilizing Sour orange seedlings with mineral solution in both seasons and poultry manure in the first season exerted the highest significant values of leaf-Zn content compared with other treatments in both seasons, while sheep and cattle manure treatments gave the lowest significant values, respectively.On the other side, Volkamer lemon seedlings of poultry manure treatment in both seasons as well as mineral treatment in the second season produced the highest significant values of leaf-Zn content compared with other treatments, which arranged significantly in a descending order as; mineral, sheep and cattle manure treatments, respectively in both seasons.

7- Leaf-Mn content:

Data in Table (5) show that mineral solution or poultry manure treatments for Sour orange and Volkamer lemon seedlings in seasons 2001&2002 achieved the highest significant values of leaf-Mn content compared with those produced by both sheep and cattle manure treatments, respectively.

8- Leaf-Fe content:

As shown in Table (5) poultry manure treatment in both seasons and mineral solution treatment in the second season gave the highest significant values of leaf-Fe content compared with other treatments in both seasons and in the tow tested rootstocks in the study.

Concerning of leaf nutrients content due to fertilize some citrus rootstocks seedlings by the aqueous extract of some irradiated animal manures are in line with the finding of (7) on Satsuma mandarin, (8) on Baladyi mandarin, (9&10) on Washington naval orange trees, who reported that fertilizing citrus trees by organic manures particularly, poultry manure improved most of leaf nutrients content.

CONCLUSION

From the above mentioned results one can say that fertilization of some citrus rootstocks seedlings namely; Sour orange and Volkamer lemon by aqueous extract of some irradiated animal manure especially poultry manure improved most growth parameters and enhanced plant dry matter content and most of leaf nutrients content . From the economical point of view, one can recommend the use of aqueous extract of some irradiated animal manure to fertilize citrus seedlings through drip irrigation system to provide them with completely nutrient solution free from pathogenic, pests and weed seeds.

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Table (4). Effect of fertilization by the aqueous extract of irradiated poultry, sheep and cattle manure on leaf –
N, P, K and Ca content of Sour orange and Volkamer lemon seedlings (2001&2002)

Treatments	Nitrogen %		Phosphorus %		Potassium %		Calcium%	
	2001	2002	2001	2002	2001	2002	2001	2002
				Sour orange rootstock				
Mineral solution	2.6 a	2.58 a	0143 a	0.144 a	0.89 b	0.90 b	4.0 ab	3.82 ab
*A.E. of irradiated poultry manure	2.57 a	2.61 a	0.142 a	0.141 a	0.95 a	0.94 a	4.15 a	4.166 a
*A.E. of irradiated sheep manure	2.52 b	2.52 b	0.130 b	0.131 a	0.85 b	0.88 b	3.77 b	3.72 b
*A.E. of irradiated cattle manure	2.41 c	2.45 c	0.121 c	0.121 a	0.75 c	0.75 c	3.22 c	3.2 c
				Volkamer lemon rootstock				
Mineral solution	2.65 a	2.62 a	0.141 a	0.143 a	0.898ab	0.915 ab	3.93 ab	4.07 ab
*A.E. of irradiated poultry manure	2.64 a	2.60 a	0.141 a	0.142 a	0.938 a	0.938 a	4.2 a	4.37 a
*A.E. of irradiated sheep manure	2.56 b	2.52 b	0.126 a	0.131 b	0.882 b	o.884 b	3.65 b	3.91 b
*A.E. of irradiated cattle manure	2.43 c	2.41 c	0.121 b	0.121 c	0.730 c	0.736 c	3.17 c	3.4 c

***A.E. = the aqueous extract of animal manure (poultry, sheep and cattle).**
Means having the same letter(s) in each column are not significantly differ at 5 % level.

Table (5). Effect of fertilization by the aqueous extract of irradiated poultry, sheep and cattle manure on leaf – Mg, Zn, Mn and Fe content of Sour orange and Volkamer lemon seedlings (2001&2002).

Treatments	Magnesium %		Zinc ppm		Manganese ppm		Iron ppm	
	2001	2002	2001	2002	2001	2002	2001	2002
Sour orange rootstock								
Mineral solution	0.54 a	0.52 a	76 a	76 a	70 a	71 a	86 b	90 a
*A.E. of irradiated poultry manure	0.52 b	0.50 a	71 a	65 b	72 a	71 a	92 a	98 a
*A.E. of irradiated sheep manure	0.43 c	0.45 b	56 b	55 c	64 b	61 b	84 b	81 b
*A.E. of irradiated cattle manure	0.33 d	0.34 c	42 c	44 d	46 c	44 c	72 c	70 c
Volkamer lemon rootstock								
Mineral solution	0.51 a	0.48 b	69 b	68 a	71 a	71 a	88 b	92 a
*A.E. of irradiated poultry manure	0.52 a	0.52 a	72 a	71 a	73 a	72 a	92 a	94 a
*A.E. of irradiated sheep manure	0.45 b	0.43 c	55 c	60 b	65 b	66 b	78 c	81 b
*A.E. of irradiated cattle manure	0.37 c	0.32 d	41 d	43 c	48 c	50 c	68 d	66 c

***A.E. = the aqueous extract of animal manure (poultry, sheep and cattle).**

Means having the same letter(s) in each column are not significantly differ at 5 % level.