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Response of Guava Transplants to Some Bio-Fertilizers

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ABSTRACT

The main target from this research aimed to study the effect of some bio-fertilizers on growth and nutritional status of guava transplants in order to reduce the mineral fertilization application during two successive seasons of 2011 and 2012. The obtained results revealed that all investigated treatments significantly increased all vegetative growth measurements (stem height, stem diameter, number of shoots per plant, number of leaves per plant and leaf area) in both seasons of study.Also, results indicated that leaf photosynthetic pigments content (chlorophyll A, B and carotenoids) were increased as well as leaf mineral contents (N, P, K, Ca, Mg, Fe, Mn and Zn) were improved by the different studied treatments. Therefore, it could be concluded that, all investigated bio – fertilizer improve growth and nutritional status especially soil application of Kotengin at 20 g/ plant + phosphorine at 40 g/ plant + Rhizobacterin at 40 g/ plant +K_2SO_4 at 20 g/ plant followed by soil application of Kotengin at 20 g/ plant + Rhizobacterin at 40 g/ plant + superphosphate at 40 g/ plant +K_2SO_4 at 20 g/ plant.

Kew words: bio-fertilizers, Guava transplants, growth and nutritional status.

Introduction

The guava "*psidium guajava* L." is believed to be native to the areas between Mexico and Peru. From there it has spreaded to all over the tropical and subtropical countries of the world, Chandler (1958).Guava fruits are the cheapest and richest source in vitamin "C", as well as it contains small amounts of vitamin "A", "B", carbohydrates, oils and proteins, Godeston and Chain (1946).

According to the latest statistics of Ministry of Agriculture of A. R. E. , in 2012, guava trees occupy 38873 feddans, which in turn produced about 314438 metric tons fruits.

Bio-fertilizers are the most importance for plant production and soil as they play an important role in increasing vegetative growth, yield and fruit quality (Soliman,2001) on guava and banana plants and (Ahmed *et al*., 1999and Osman *et al.,* 2010) on olive plants, (Chokha *et al.,* 2000; El-Geuoshy, 2011 and Bakry *et al.,* 2013) on sweet orange. Also, Shaban and Mohsen (2009)showed that, all bio-fertilizers were effective in improving vegetative growth and nutritional status of sweet orang transplants.

Bio-fertilization are biological preparations containing primarily patent strains of micro- organisms insufficient numbers. These micro- organisms have definite beneficial roles in the fertility of soil rhizosphere and consequently reflected positively on plant growth. The multi- strain bio-fertilizers might contain different strains of symbiotic associative diazatrophes, phosphate- solubilizing micro-organisms, silicate dissolving micro- organisms, blue green algae and VAM (Saber, 1993).

Bio-fertilizers proved to eliminate the use of pesticides sometimes and rebalance the ratio between plant nutrients in soils. They are easy and safe to handle with field applications that improved their efficiency in increasing crop yields and decreasing the costs of some agricultural practices. It is worthy tostatethat,bio-fertilizersdonotreplacemineralfertilizers,butsignificantlyreducetheirrateofapplication (Ishac,1989).

Bio-fertilizersare very safe for human, animal and environment. Since, they reduce at the lower extent the great pollution happened in environment. Phosphorine is abio-fertilizer product containing active micro organism shydrolyzing the insoluble phosphatein to soluble one under high soil pH and greater percentage of calcium carbonate, consequently partially overcomes the phosphate fixation. In addition, Rhizobacterin as new bio-fertilizers have greater amount of symbiotic bacteria responsible of symbiotic and nosymbiotic bacteria responsible for nitrogen fixation. Application of both achieved the following merits:

1-Reducing plant requirements of nitrogen by 25%; 2- Improving the availability of various nutrients for plant absorption; 3-Increasingtheresistanceofplantstorootdisease; 4-Reducing the environmental pollution induced by the application of chemical fertilizers; 5-Improvingtheproductivityof the trees.

A variety of bio-fertilizers are now available commercially. Specific strains are used as biological fertilizers, for nitrogen, phosphorus and silicate dissolving such as N-fixing bacteria and yeasts. The use of these materials encourages yield and keeps the environment clean.

The present study aimed to throw some light on the beneficial effect of replacing mineral N, P and K soil application with some bio-fertilizers namely, Phosphorine, Rhizobacterin, Biovit, hummer, Kotengin and bio-stimulant (Biomagic) on growth and nutritional status of guava transplants.

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Materials and Methods

The present investigation was carried out during two successive seasons of (2011 and 2012) at nursery of Horticulture, Faculty of Agriculture, Benha University.

Uniform and healthy one-year- old seedlings of guava *"Psidium guajava,* L.*"* were the plant material used in this study. In both seasons of study and during the first week of February, these seedlings were transplanted individually each in plastic pot of 35cm. in diameter that previously had been filled with specific weight of growing medium consisting of clay and sand at equal proportion (by volume).

Before the experiments had been conducted in the first season, both mechanical and chemical analysis of growing medium were done as shown in Table (1 a& b) according to the methods described by Jackson, (1967) and Israelsen and Hansen (1962).

Table (1-a): Physical properties of soil (%).

Partial distribution		
Total sand	Silt	Clay
65.00%	10.00%	25%

Table (1-b): Chemical properties of soil.

EC	PH	Ca Co3	Soluble anions meg /L				Soluble cations mg/L			
			Cl^-	$SO4^{--}$	$CO3^{--}$	$HCO3^-$	Na^+	K^+	Ca^{++}	Mg^{++}
1.90	7.72	1.30	6.90	9.20	-	3.00	7.70	0.60	8.80	2.10

The bio-fertilizer (BF) which used in this study were produced by soil microbiology unit, desert research center. This experiment involved eight treatments:

1- Mineral NPK fertilization program as control was annually added at the rate of 40gammonium sulphate, 40g superphosphate and 20 g potassium sulphate per pot (plant). Whereas, the corresponding amount of each NPK fertilizer was fractionized into five equal doses to be soil applied monthly from mid March till mid July during every season.
2- Soil application of Kotengin at 20 g/ plant + NPK application of control.
3- Soil application of Biomagic at 7.5 g/ plant + NPK application of control.
4-Soil application of Hummer at 1 g/ plant + NPK application of control.
5- Soil application of Kotengin at 20 g/ plant + phosphorine at 40 g/ plant +NK soil added with control.
6- Soil application of Kotengin at 20 g/ plant +Rhizobacterin at 40 g/ plant + PK soil added with control.
7- Soil application of Kotengin at 20 g/ plant + phosphorine at 40 g/ plant + Rhizobacterin at 40 g/ plant +K_2SO_4 at 20 g/ plant.
8- Soil application of Kotengin at 20 g/ plant + one liter Biovit (prepared by dissolving one liter of commercial Biovit in 50 liter water) + K_2SO_4 at 20 g/ plant.

- Bio-fertilizers (Kotengin, Biomagic,Phosphorine, Rhizobacterin, Biovit and Hummer each of them were applied once/ year in March.

The response of guava seedlings to differential treatments were investigated throw determining of the following measurements.

1- Vegetative growth measurements:

On last week of October during both seasons as the experiment was ended, the effect of different treatments on some vegetative growth measurements were evaluated by the following growth parameters during both seasons as follows:

Increment percentage in stem height, increment percentage in stem diameter, average number of shoots / plant, average number of leaves / plant and average leaf area.

2- Chemical analysis:

Photosynthetic pigments (chlorophyll A, B and carotene) and leaf mineral content (N, P, K, Ca, Mg, Fe, Mn and Zn) were determined described by A.O.A.C. (1990)

Statistical analysis:

All data of the present investigation were subjected to analysis of variance and significant differences among means were determined according to (Snedecor and Cochran, 1977). In addition, significant differences among means were differentiated according to the Duncan's, multiple test range (Duncan, 1955).

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Results and Discussion

A- Vegetative growth measurements:

In this regard, increment percentage in stem height, increment percentage in stem diameter, average number of shoots / plant, average number of leaves / plant and leaf area were the investigated growth parameters of guava transplants as influenced by the differential bio-fertilizers (Kotengin, Biomagic, Phosphorine, Rhizobacterin, Biovit and Hummer)treatments. Data obtained during both 2011& 2012 experimental seasons are presented in Table (2).

Table 2: Effect of mineral NPK fertilizers and their combinations with some bio – fertilizers soil applied on vegetative growth measurements of guava transplants during both 2011 &2012 experimental seasons.

Treatments	Increment (%) in stem height		Increment (%) in Stem diameter		No. of Shoots per transplant		No. of leaves per transplant		Leaf area (cm^2)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
1	24.79G	22.03H	16.89F	16.64G	1.00G	1.00G	50.54H	50.79G	21.05F	20.40H
2	37.95F	36.07G	29.65E	38.43F	1.67F	1.67F	67.64G	68.15F	36.94DE	31.58G
3	46.05E	44.44F	37.70D	40.21E	2.33E	2.33E	75.97F	76.37E	33.85E	33.20F
4	56.08D	46.02E	40.03D	40.52E	3.33D	3.33D	88.92E	78.33E	35.89DE	38.82E
5	63.03B	59.45D	40.55D	45.94D	5.67C	5.00B	122.36D	122.86D	38.18CD	40.62D
6	77.78A	74.46B	56.66B	56.67B	7.00B	4.00C	156.38B	143.68B	46.67B	53.44B
7	77.93A	79.21A	74.81A	76.03A	8.00A	4.67B	171.23A	169.43A	52.99A	56.82A
8	61.43C	62.53C	44.00C	49.59C	6.00C	6.00A	137.32C	132.78C	41.11C	47.48C

Values within each column followed by the same letter/s are not significantly different at 5 % level.

T1= Control (40,40,20 g/plant of superphosphate, $(NH_4)_2SO_4$, K_2SO_4, respectively).
T2= 20 g Kotengin / plant + NPK applied of control.
T3= 7.5 g Biomagic at / plant + NPK applied of control.
T4 = 1.0 g Hummer at / plant + NPK applied of control.
T5= 20 g Kotengin + 40 g phosphorine per plant + NK applied of control.
T6=20 g Kotengin + 40 g Rhizobacterin per plant + PK applied of control.
T7=20 g Kotengin + 40 g phosphorine + 40 g Rhizobacterin / plant +20 g K_2SO_4 / plant.
T8=20 g Kotengin at / plant + 1.0 liter diluted Biovit solution + 20 g K_2SO_4 / plant.

It is quite evident as shown from Table (2) that, all investigated bio- fertilizer treatments increased significantly the above mentioned five growth parameters as compared to control. However, the response varied obviously from one treatment to another, in spite of all growth parameters followed in most cases the same trend during both experimental seasons. Anyhow, the soil application of Kotengin at 20 g/ plant + phosphorine at 40 g/ plant + Rhizobacterin at 40 g/ plant +K_2SO_4 at 20 g/ plant (7th treatment) was the most effective and ranked statistically 1st, whereas it resulted in the greatest average stem (height& thickness), number of shoots per transplant, number of leaves per shoot and average leaf area during both experimental seasons. On the contrary, the least values of all investigated growth parameters were significantly exhibited by (control). In addition, other investigated treatments were in between the aforesaid two extremes.

This result goes in line with the findings Izquierdo *et al.,* (1993) and Chokha *et al*., (2000) on growth measurements of bio-fertilized Volkamer lemon and Mosambi sweet orange, respectively as they gave support to the obtained result particularly as the benefit effect of Biomagic application was concerned.

On the other hand, the noticeable positive effect of six investigated bio – fertilizers may be attributed to the improvement in soil physical and chemical properties induced by the additional N source like as Kotengin, Biomagic, Phosphorine, Rhizobacterin, Biovit and Hummerwhich reflected positivelyon various nutrient absorption.

B- Nutritional status (leaf photosynthetic pigments and mineral composition):

Leaf N, P, K, Ca, Mg, Fe, Mn, Zn and photosynthetic pigments (chlorophyll A, B and carotenoids) contents were determined as an indicator of nutritional status of guava transplants in response to different bio-fertilizer treatments. Data obtained during both 2011& 2012 experimental seasons are presented in Tables (3 and 4).

It was so worthy as shown from Tables (3 and 4) that, all leaf macro and micro elements content (N, P, K, Ca, Mg %, Fe, Mn, and Zn ppm) and leaf photosynthetic pigments were increased significantly by any of the investigated bio- fertilizers treatments as compared to control. such trend was true during both seasons of study. Anyhow, soil application of Kotengin at 20 g/ plant + phosphorine at 40 g/ plant + Rhizobacterin at 40 g/ plant +K_2SO_4 at 20 g/ plant.(7th treatment)was the most effective and exhibited statistically the highest leaf macro and micro nutrient elements content during both seasons. On the other hand, soil application of Kotengin at 20 g/

plant +Rhizobacterin at 40 g/ plant + superphosphate at 40 g/ plant +K_2SO_4 at 20 g/ plant (6thtreatment) ranked statistically 2nd.

This result goes in line with Abd El-Migeed *et al.,* (2007) and EL- Geuoshy (2011) on Washington navel orange. Moreover, findings of Osman *et al.,* (2010) on two olive cultivars were in partial agreement with the present result in this respect regarding the simulative effect of some bio fertilizers.

Table 3: Effect of mineral NPKfertilizers and their combinations with some bio – fertilizers soil applied on leaf macro nutrient elements contents of guava transplants during both 2011 &2012 experimental seasons.

Treat.	Leaf N %		Leaf P %		Leaf K %		Leaf Ca %		Leaf Mg %	
	1st season	2nd season	1st season	2nd season	1st season	2ndseason	1st season	2nd season	1st season	2nd season
1	1.70F	1.65H	0.20F	0.42E	1.42H	1.40F	1.51H	1.53H	0.55H	0.56G
2	1.82E	1.78G	0.28E	0.50D	1.45G	1.44F	1.60G	1.58G	0.64G	0.63F
3	1.88D	1.90F	0.36D	0.55D	1.60F	1.60E	1.72F	1.71F	0.77F	0.76E
4	1.91D	2.64D	0.50C	0.62C	1.73E	1.70D	1.81E	1.86E	0.80E	0.82D
5	1.92D	2.98C	0.49C	0.90B	1.95C	1.98C	1.98C	1.95C	0.83D	0.86C
6	3.01B	3.32B	0.63B	0.94AB	2.30B	2.45B	2.45B	2.61B	0.93B	0.95B
7	3.29A	3.92A	0.67A	0.97A	2.40A	2.93A	2.74A	2.68A	0.95A	0.97A
8	2.15C	2.06E	0.66A	0.98A	1.83D	1.96C	1.88D	1.89D	0.85C	0.87C

Values within each column followed by the same letter/s are not significantly different at 5 % level.

T1= Control (40, 40, 20 g/plant of superphosphate, $(NH_4)_2SO_4$, K_2SO_4, respectively).
T2= 20 g Kotengin / plant + NPK applied of control.
T3= 7.5 g Biomagic at / plant + NPK applied of control.
T4 = 1.0 g Hummer at / plant + NPK applied of control.
T5= 20 g Kotengin + 40 g phosphorine per plant + NK applied of control.
T6= 20 g Kotengin + 40 g Rhizobacterin per plant + PK applied of control.
T7= 20 g Kotengin + 40 g phosphorine + 40 g Rhizobacterin / plant +20 g K_2SO_4 / plant.
T8= 20 g Kotengin at / plant + 1.0 liter diluted Biovit solution + 20 g K_2SO_4 / plant.

Table 4: Effect of mineral NPKfertilizers and their combinations with some bio – fertilizers soil applied on leaf micro nutrient elements and photosynthetic pigments contents of guava transplants during both 2011 &2012 experimental seasons.

Treat.	Fe (ppm)		Zn (ppm)		Mn (ppm)		Chlorophyll (A) (mg/ g F. W.)		Chlorophyll (B) (mg/g F. W.)		Carotene (mg/ g F. W.)	
	1st season	2nd season	1st season	2nd season	1st season	2ndseason	1st season	2nd season	1st season	2nd season	1st season	2nd season
1	150.5F	147.5H	47.33G	50.00G	81.00E	83.83D	3.22G	3.27G	1.90G	1.93G	2.55G	2.60G
2	175.5E	180.0G	56.67F	56.00F	86.00D	93.50C	3.50F	3.56F	1.97FG	1.98G	2.70F	2.73F
3	198.0D	205.0F	64.00E	66.67E	89.67C	94.67C	4.10E	4.13E	2.04EF	2.08F	2.85E	2.89E
4	213.0C	247.5D	64.33E	70.67D	93.00B	96.67C	4.50D	4.55D	2.10E	2.17E	2.95D	2.97D
5	215.0C	252.5C	68.00D	76.00C	94.33B	108.67B	4.88C	4.92C	2.32D	2.37D	3.15C	3.20C
6	225.5B	282.2B	78.00B	80.00B	112.00A	116.67A	6.47A	6.53A	2.94B	2.97B	3.88A	3.91A
7	276.0A	287.5A	82.00A	86.00A	114.00A	118.33A	6.52A	6.55A	3.10A	3.15A	3.92A	3.94A
8	229.5B	242.5E	71.33C	76.67C	94.00B	97.33C	5.10B	5.18B	2.68C	2.67C	3.32B	3.34B

Values within each column followed by the same letter/s are not significantly different at 5 % level.

T1= Control (40, 40, 20 g/plant of superphosphate, $(NH_4)_2SO_4$, K_2SO_4, respectively).
T2= 20 g Kotengin / plant + NPK applied of control.
T3= 7.5 g Biomagic at / plant + NPK applied of control.
T4 = 1.0 g Hummer at / plant + NPK applied of control.
T5= 20 g Kotengin + 40 g phosphorine per plant + NK applied of control.
T6= 20 g Kotengin + 40 g Rhizobacterin per plant + PK applied of control.
T7= 20 g Kotengin + 40 g phosphorine + 40 g Rhizobacterin / plant +20 g K_2SO_4 / plant.
T8= 20 g Kotengin at / plant + 1.0 liter diluted Biovit solution + 20 g K_2SO_4 / plant.

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