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EFFECT OF BIOPROMOTORS AND BIOFERTILIZERS APPLICATION ON GROWTH AND CHEMICAL COMPOSITION OF JOJOBA PLANTS

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ABSTRACT

A pot experiment was established during two successive seasons to evaluate the effect of biopromotor which is commercial product known as Biomagic (0,5,7.5,10g/l)and bacterial inoculation with *Azotobacter, Bacillus* and their mixture on the growth and chemical composition of jojoba (*Simmondisa chinensis* (Link) Schneider) plant. Experimental results indicated that, all applied treatments significantly increased vegetative growth prameters compared with control treatment. The highest values were always obtained from sprayingt plant with the high rate of Biomagic (10g/l) and inoculation with mixture of *Azotobacter* and *Bacillus.* The highest values of pigments were always obtained from spraying plant with the medium rate of Biomagic (7.5g/l) and inoculation with *Azotobacter* . The highest total carbohydrates in leaves, shoots and roots were recorded with spraying Biomaic at (10g/l) presence of mixture of *Azotobacter,* and *Bacillus* . The effect of Biomagic application and bacterial inoculation on leaves, shoots and roots content of mineral element was significantly increased compared with control treatment.

Spraying Biomagic at high concentration (10g/l) plus inoculation with *Azotobacter* caused a high accumulation of N,K, Cu and Mn in jojoba leaves, shoots and roots followed by high concentration of Biomagic and inoculation with mixture of *Azotobacter,* and *Bacillus* . Using (10g/l) Biomagic and inoculation with *Bacillus* promoted a higher accumulation of elements P, Fe and Zn on jojoba tissues followed by the same concentration of Biomagic and dual inoculum.

INTRODUCTION

Jojoba { *Simmondsia chinensis* (Link) Schneider} pronounced hohoba, also called Goat Nut which belong to family, Simmondsiaceae, native to the southwestern United States, southern California, Arizona and northern Mexico (National Research Council,1985).

Jojoba is a perennial, dioecious, evergreen shrub or small tree that lives under diverse environmental conditions.

Recently, the use of extracts of living organisms as a foliar spray for the biostimulants has been increased . The most widely used biostimulants under the Egyptian conditions are that extracted from the micro-organisms, such as Biomagic, or from sea algae e.g. Promox, Sida compound, Dash or extraction of Baker's yeast. Such extraction contains micro and macro elements, amino acid, vitamins, and plant hormones (El- Sayed, 2005) .

Nitrogenous and phosphorus chemical fertilizers are commonly used, but with application of such fertilizer to the soil, some problems could be arise, e.g. some nitrogen could be lost via nitrate reduction, denitrification and / or ammonia volatilization. In addition, some amounts of nitrogen can be evaporated from soil surface and leached through under ground water, immobilization of phosphorus is the most important problem of phosphate fertilization, which attributes to the high soil reaction where soil PH usually surpasses 8.0 causing inhibition in nutritional uptake. Therefore the use of biofertilizer is of particular interest to avoid the previously mentioned problems.

Moreover, microorganisms which are used as a biofertilizer induce stimulative effect of plant growth and production by fix atmospheric nitrogen in a free living state, e.g. *Azotobacter* and *Azospirillum* (Darwish, 2002) .

In addition, *Bacillus megatherium* mobilize phosphate and micronutrients, while *Azotobacter* and *Bacillus* secret growth promoting factors, e.g. gibberellin, cytokinin like substances and auxins (Darwish, 2002) .

The objective of this work is to examine the response of jojoba plant to Biomagic and bacterial inoculation under sandy soils with special emphasis on growth parameters and chemical composition.

MATERIALS AND METHODS

A.pot experiment was carried out at the Experimental Nursery of Department of Ornamental Horticultural, Faculty of Agriculture, Cairo University,Giza during the period from 2002 until 2005. This investigation aimed to study the influence of foliar spray with biopromotor which is commercial product known as Biomagic (0,5,7.5 and 10 g/l) and bacteria inoculation (uninoculated, *Azotobacter chroococcum* (Ar72) *Bacillus megatherium* var *phosphaticum* (Ar18) , *A. chroococcum xB. megatherium*) on growth and chemical composition of jojoba plants (*Simmondsia chinensis* (Link) Schn.). Seeds of jojoba were secured from El-kassasin Horticultural Experimental Station. Ismaillia Governorate, Ministry of Agriculture . On Augist 15 th and 17 th, 2002 and 2003 (in first and second season, respectively) the seeds of jojoba were sows in plastic pots (10 cm- diameter) filled with sandy soil .

On February 15 th of each season the seedlings (20 cm,and 10-12 leaf/ plant in average) were planted in plastic pots (30 cm-diameter) filled with a constant weight (10 kg./each) of sandy soil. This soil was brought from El-Khatattba area, Menoufiya Governorate.

The physical characteristics of soil was carried out according to standard methods outlined by Klute (1986) and chemical analysis of soil was carried out according to standard methods outlined by Page (1982) and the data are listed in Table A.

All Plants received equal amount of chemical fertilizer and sheep manures. The chemical analysis of the organic fertilizer (Table , B) were made according to Page (1982) .

Table A. some physical and chemical properties of experimental soil samples.

Characteristics	2003/2004	2004/2005
Ec mmhos/ cm at 25ºc	0.27	0.25
PH (1:2.5 H20)	9.00	8.90
Particle size distribution:		
Sand	90.12	90.32
Silt	1.00	1.00
Clay	8.88	8.68
Textural Class	Sandy	Sandy
Soluble ions (meq/1) :		
Cations :		
Ca $+^2$	0.20	0.60
Mg $+^2$	0.60	0.20
Na $^+$	1.14	1.11
K^+	0.22	0.26
Anions:		
$Co_3{}^{-2}$	--	--
$HCO_3{}^-$	0.60	0.80
Cl^-	1.50	1.00
$So_4{}^{-2}$	0.06	0. 37
Available sutrient (PPm) :		
N	30.00	30.00
P	8.00	17.00
K	32.00	80.00
Fe	2.80	1.52
Cu	0.30	0.02
Zn	0.10	0.16
Mn	0.80	0.06

Table B. The Chemical analysis of sheep manure applied to jojoba plant during 2003/2004 and 2004/2005 seasons .

Characteristics	2002/2003	2003/2004
Density (Kg/m^3)	670	590
Relative humidity	46.70	43.20
Ec mmhos/cm at 25 ºC	13.56	11.86
PH (1:10 H20)	8.40	9.20
Organic mater	50.00	48.50
Organic Carbon	29.00	28.1
Total		
N (%)	1.68	1.51
P(%)	0.59	0.66
K (%)	4.78	5.98
Fe ppm	3310	3312
Zn ppm	94.80	133.05
Cu ppm	48.15	51.00
Mn ppm	264	274

All biofertilizer (*Azotobacter chroococcum* (Ar72) *Bacillus megatherium* var *phosphaticum* (Ar18) , *A. chroococcum xB. megatherium*) were added around the plant root in pots, the rate used were 150 ml/pot in each time on March and September in both seasons .Jojoba plants were sprayed with Biomagic periodically every 15 days starting from 15 days after transplanting (1 st March) up to 31 th October. Biomagic has PH of 5.5 and Consists of :

I- **Amino acids (1.907%)**

1. Arginine	2. Cystine	3. Glycine
4. Histidine	5. Isoleucine	6. Leucine
7. Lysine	8. Phenylalanine	9. Theronine
10. Tryptophane	11. Tyrosine	12. Valine

II-**Vitamins (0.038%):-**

1. Thiamin	2. Biotiene	3. Choline
4. Folic acid	5. Niacin	6. Pantothinic
7. Pyrodxine	8. Rhiboflavin	

III-**Macro elements (in mg/1):-**

1. N 1125	2. P_2O_5 550	3. K_2O 625

IV. Micro elements (in mg/1)):-

1. Fe 160	2. Zn 124	3. Mn 100
4. Mg 45	5. Cu 45	6. B 14
7. Mo 12	8. Cd 7	9. Ni 4

The following data were recorded at the end of growth season (12 months).

- Plant height (cm)
- Stem diameter (cm).
- Number of branches / plant.
- Number of Leaves / plant.
- Fresh weight of leaves, shoots, and roots.
- Dry weight of leaves, shoots and roots .
- Pigments content (mg/g f. w.): chlorophyll a,b and carotenoids in the fresh leaves.
- Total carbohydrates contents percentage in the leaves, shoots and roots.
- Elements contents (N,P,K,Fe, Cu, Zn and Mn) were determined in the leaves, shoots and roots.

Chlorophylls and carotenoids were determined in leaf samples (mg/g fresh weight) using the method described by Nornai (1982). The Concentrations of total carbohydrates was determined in dried leaves, stem and roots using the methods described by Dubois *et al.* (1956).

Nitrogen concentration was determined by the micro kieldahl apparatus of Parnas Wanger as described Van-Schouwenburg and Walinga (1978). Phosphorus was estimated calorimetrically by using the chlorostannous reduced molybyophoshoric blue colour method as described by king (1951) . Potassium concentration was detarnined by using the flame photometer (Corning 410).

Determination of micronutrients (Fe,Cu, Zn and Mn) concentrations were determined by the atomic absorption spectrophotometer (Thermo Jarrellas H, AA SCANI) .

Experiments conducte in this study followed a Complete randomized design in factorial experiment. The obtained data were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1980). Differences between means of treatments were Compared using LSD Values at 0.05 level .

RESULTS AND DISCUSION

1- Vegetative growth characters

It is clear from data in Tale1,2 and 3 that Biomagic increased the different growth parameters compared with control . The stimulation effect of Biomagic in vegetative growth characters was increased with increasing the concentration used. The maximum values were recorded with the high concentration of Biomagic (10 g/l) .

These results were in agreement with those obtained by Abdel- Hameed (2002) on olive trees ,Aly (2002) on pea, Hanafy *et al.* (2007) on tomato, Salama (2005) on globe artichoke. Biomagic played an important regulatory role in plant growth development as well as yield and its component by enhancing the endogenous levels of various growth factors such as cytokines and gibberellins (Hanafy *et al.* 2007) . It worth here to mention that Biomagic is safe for environment to get lower chemical pollution effects. Also this natural compound reduced soil salinity via decrease using of mineral fertilization .

Regarding to the effect of bacterial inoculation, the obtained results indicates also that the alone inoculation with *Azotobacter* and *Bacillus* and their mixture, remarkably increased the different growth parameters compared with uninoculated plant as shown in the same tables. The least values were generally noticed with uninoculated control plant but the maximum values were recorded with treatment of mixture, of *Azotobacter* and *Bacillus*

These results are confirmed by Mohamed an Ram (1988) on *Eucalyptus camaldulensis*, Remesh *et. al* (1998) on nut seedlings, Abdel - Hameed (2002) on olive, Meantime it is clear that the beside the primarily function of *Azotobacter* nitrogen fixation, it has been also well documented the ability of *A. chroococcum* to synthesize and secrete some vitamins such as thiamine, riboflavin, pyridoxine, cyancobolamine, nicotinic and pantothenic acid, and some plant hormones e.g., indole substances, in addition to synthesizing antifungal antibiotics, which gave additional advantages for using *A. chroococcum* in the field or bio production (Subba Rao, 1993). Meanwhile, *Bacillus megatherium* has been found to convert bond phosphates, such as super phosphate and rock phosphate .into forms, which are easily assimilated by the plant .

In general, data of vegetative growth of jojoba during the two seasons were significantly affected by application of Biomagic and dual inoculation with *Azotobacter* and *Bacillus* compared with the control and / or the most other treatments. It was also found that the maximum values were recorded with using the high rate of Biomagic (10g/l) when inoculation with mixture of *Azotobacter* and *Bacillus.*

T1

T2

T3

II- Pigments :-

1- Chlorophyll "a" content (mg/g f.w.) :

It was clear from data in Table (4) for both seasons that chlorophyll "a" content of jojoba plant was considerably influenced by spraying with Biomagic. Application of Biomagic at different rates led to increase in the leaf content of chlorophyll "a" compared with untreated plants. Control plants had the lowest chlorophyll a content. Meanwhile Biomagic at the medium rate (7.5 g/l) produced the highest value of chlorophyll " a" content followed by the high rate.

Regarding the effect of bacteria on the chlorophyll "a" content of jojoba leaves.The least values were generally noticed with unioculated control plants during two seasons. The highest chlorophyll " a" content was recorded with the plants inoculated with *Azotobacter* followed by the treatment of inoculation with the two bacterial mixture.

Moreover, the interaction effect between Biomagic rates and bacterial inoculation on the chlorophyll " a " content of jojoba in Table (4) data reveal that, the hightest of percentage content was produced with sprayed plants with Biomagic at the rate of 7.5 g/l when inoculated with *Azotobacter.* In the second rank lies the value observed with plants sprayed with Biomagic at the rate of 7.5 g/l when inoculated with mixture of bacteria. The increases in chlorophyll "a" content with these two treatments were significant when compared with the control. Similar results was recorded by Sharma and Bhutani (1998) on apple seedlings.

2- Chlorophyll "b" content (mg/g f.w.) :

The results in Table (4) indicate that the chlorophyll "b" content followed a trend similar to that obtained in the chlorophyll "a". The medium and high rates of Biomagic showed a more pronounced effect on chlorophyll "b" content than untreated or the low rate of Biomagic.

Also , the Chlorophyll "b" content was considerably affected by inoculation with bacteria, The highest chlorophyll "b" content was recorded with plants inoculated with *Azotobacter* followed by the treatment of inoculation with the two bacterial mixture, but without significancy between themselves.

Data presented in Table (4) showed that chlorophyll "b" content affected by the combination between Biomagic and bacteria treatments in the first season. The treatments which included Biomagic at the rate of 7.5 g/l and inoculation with *Azotobacter* alone and the mixture of *Azotobacter* + *Bacillus* were more effective and show increasing on the synthesis and accumulation of chlorophyll "b" than control and the other treatments. On the other hand in the second season treated plant with high Biomagic concentration (10g/l) and dual inoculation of *Azotobacter* and *Bacillus* produced the best values of chlorophyll "b".

T4

3- Total chlorophylls (a+b) (mg/g f.w.) :

Regarding the effect of different Biomagic concentrations on the leaves total chlorophylls (a+b) (Table4) it noticed that, all Biomagic treatments had a pronounced effect on increasing the content of total chlorophylls in leaves compared to control. It can observed that Biomagic at medium concentration (7.5 g/l) had considerable effect on the leaf content and gave the highest percentage of total chlorophylls in leaves.

It can be noticed that the total chlorophylls (a+b) content was considerably affected by inoculation with bacteria. The highest total chlorophylls content was recorded with plants inoculated with *Azotobacter* followed by the treatment of inoculation with the two bacterial mixture, but without significancy between themselves.

As for the combination effect of Biomagic rates and bacterial inoculation on the total chlorophylls of jojoba leaves, the highest of percentage content was produced with sprayed plants with Biomagic at the rate of (7.5 g/l) when inoculated with *Azotobacter* .

Carotenoides content (mg/g f.w.)

The data in Table (4) indicate that, application of Biomagic at different rates led to increase in the leaf content of carotenoides compared with control plants .Sprayed plants with Biomagic at (10 g/l) produced the highest value of carotenoides content.

Regarding the effect of bacterial inoculation Table (4) on the carotenoids content of jojoba leaves, uninoculated control had lower carotenoids content than inoculated. The highest carotenoids content determined in leaves of plants inoculalated mixtured of bacteria in the first season and *Azotobacter* in the second season .

Data presented in Table (4) showed that carotenoides content was positively affected by either increasing Biomagic rates or Bacteria inoculation. The best values were recorded with using the 10g/l Biomagic with individual *Azotobacter* followed by 7.5 g/l Biomagic with inoculation by *Azotobacter* alone or mixed with *Bacillus* but without significany between themselves Similar results was recorded by Aly (2002) on pea plants.

III Total carbohydrates (%) :

Experimental data presented in Table (5) indicated that the total carbohydrates of leaves, shoots and roots were significantly affected by Biomagic rates . The general increase of total carbohydrates in leaves ,shoots and roots as a result of using Biomagic treatments are shown in Table (5) . Plant supplied with different Biomagic concentration recorded an increase in total carbohydrates in their leaves, shoots and roots . The greatest values were recorded on plant treated by the high Biomagic rate (10g/l), and followed by the medium rate (7.5g/l), but without sigificancy between themselves.

Concerning the effect of bacterial inoculation in general , the values of total carbohydrates in leaves, shoots and roots were increased due to inoculation treatments.

T5

In this regard, the least values were generally noticed with the uninoculated control plant during two seasons but the best values were recorded with dual inoculation treatment. As for the combination effect of Biomagic rates and bacterial inoculation on the total carbohydrates in
leaves, shoots and roots .The highest total carbohydrates in leaves, shoots and roots were recorded with plants inoculated with *Azotobacter* and Bacillus presence of high concentration of Biomagic (10 g/l).

V. Nutrient contents :

1. Nitrogen Content (%):

Data presented in Table (6) reflected significant effect for Biomagic concentrations on nitrogen contents in leaves, shoots and roots. Using Biomagic at high rate (10 g/l) markedly promoted a high nitrogen content in leaves, shoots and roots of jojoba plants compared to control and other rates of Biomagic .

Bacterial inoculation, in most cases, reflected enhancement of N content of leaves, shoots and roots compared to the unioculated treatment, especially in case of *Azotobacter* where the highest values were recorded followed by dual inoculation treatment but without significancy between themselves.

Nitrogen uptake by leave, shoot and root of jojoba plants was presented in Table (6). It seems that the N uptake was positively affected by Biomogic and bacteria inoculation. The highest N content recorded with treatment of spraying with Biomagic at the high concentration (10 g/l) and inoculation with *Azotobacter*, followed by the treatment of inoculation with the two bacterial mixture amended with high rate of Biomagic (10 g/l) but without significany between them .

2- Phosphorus content (%):

It is clear from data in table (7) that P percentages in leaves, shoots and roots of jojoba plants were considerably increased by Biomagic treatments. The highest P% recorded with the treatment of high concentration of Biomagic (10g/l). The favorable effects of Biomagic treatments on P- content on jojoba were similar to that result obtained by Abdel- Hameed (2002) on olive, Aly (2002) on Pea, Salama (2005) on globe artichoke.

The obtained results indicate also that the alone inoculation with
Azotobacter or Bacillus, and their mixture slightly increased the P content compared with unioculated onces. The highest P percentages in leaves, shoots and roots of jojoba plant were recorded with the treatment of *Bacillus* inoculation followed by dual inoculation of *Azotobacter and Bacillus*, but without significancy between themselves . Similar results were recorded by, Sorial *et al* . (1992) on tomato, Haggag *et. al* (1994) guava seedlings .
As regards, the combination effect of Biomagic rates and bacterial inoculation on concentration of P in leaves, shoots and roots of jojoba plant data revealed that the highest P% recorded with the treatment of Biomagic at the high concentration (10g/l) with *Bacillus* inoculation followed by above concentration of Biomagic (10 g/l) with the treatment of dual inoculation of *Azotobacter and Bacillus*.

T6

T7

3- Potassium content (%):

It is evident from the results in Table (8) that K-content showed similar trend as that in N content. The different Biomagic concentrations had generally a little effect on K- contents in leaves, shoots and roots of jojoba plant.

Concerning the effect of bacterial inoculation, it was found that the maximum values were recorded with the treatment of inoculation with *Azotobacter* followed by mixture of *Azotobacter and Bacillus*, but without significancy between themselves. Meantime, it is clear that spraying Biomagic with (10g/l) to *Azotobacter* and /or mixture of *Azotobacter and Bacillus* generally increased the obtained results over the control.

4- Iron content (mg/g) :

Data presented in Table (9) showed that Fe uptake by leaves, shoots and roots was positively affected by either increasing Biomagic concentration or bacterial inoculation.

Concerning the effect of Biomagic, it is obvious that Fe absorption was gradually increased with increasing Biomagic concentration. Also, the results of both leaves, shoots and roots were nearly closed to each other. Generally, the highest values of Fe content in leaves, shoots or roots were recorded with spraying high concentration of Biomagic (10g/l). Similar result, was recorded by Abdel – Hameed (2002) on olive .

From the results, it can be recognized that, bacterial inoculation (Table,9) increased Fe uptake by leaves, shoots, or roots especially in case of *Bacillus* inoculation treatment where, the highest values were recorded, followed by dual inoculation treatment, but without significancy between them.

The Fe contents as affected by the interaction effect between Biomagic and bacteria . The highest value of Fe was produced with plants inoculated with *Bacillus* or *Azotobacter and Bacillus*,in the precence of spraying with (10g/l) Biomagic .

5- Copper Content (mg/g) :

It is evident from the data in Table (10) that Biomagic treatments considerably affected the Cu contents in leaves, shoots and roost of jojoba plants, i.e. sprayed plants had more Cu concentration in their tissues than control plants . The more effective concentration was Biomagic at (10g/l) .

Concerning the effect of bacterial inoculation, in general, increase in Cu uptake by leaves, shoots, and roots especially in case of *Azotobacter* inoculation treatment where the highest values were recorded.

As for effect of interaction between applied Biomagic and bacterial inoculation in the (Table 10), the combination between high concentration of Biomagic (10g/l) and *Azotobacter* inoculation was more effective in increasing Cu content in jojoba tissues than other combination inoculation. In general, increase in Cu uptake by leaves, shoots, and roots especially in case of *Azotobacter* inoculation treatment where the highest values were recorded .

T8

T9

10

As for effect of interaction between applied Biomagic and bacterial inoculation in the (Table 10), the combination between high concentration of Biomagic (10g/l) and *Azotobacter* inoculation was more effective in increasing Cu content in jojoba tissues than other combination .

6-Zinc content (mg/g) :

As shown in Table (11), the acquisition of Zn by leaves, shoots and roots of jojoba plants was frequently affected by either Biomagic or bacterial inoculation.

Zinc in leaves, shoots and roots tended to increase with increasing Biomagic. Thus the highest content of Zn content was recorded on plants sprayed with Biomagic at the concentration of (10g/l).

Concerning the effect of bacterial inoculation in general, the values of Zn uptake by leaves, shoots and roots were increased by inoculation treatments. In this regard the best values were recorded with individual *Bacillus* followed by the treatment of inoculation with the two bacterial mixture. Regarding the effect of Biomagic rates combined with bacterial inoculation treatments on the Zn content Table (11), data reveal that, this combination had pronounced effect an increasing the content of Zn than control plants.

Generally, the highest values of Zn content in leaves, shoots or roots were recorded by spraying with high concentration of Biomagic and inoculation with *Bacillus*.

7- Manganese content :

Data in Table (12) reveal that, Biomagic treatments had remarkable effect on Mn content in leaves, shoots and roots of jojoba plant. The highest Mn content was produced with plants sprayed with Biomagic at high concentration (10g/l). It appears from Table (12) that the least values of Mn in leaves, shoots and roots were generally noticed with the uninoculated control plant during the two seasons. The highest Mn content was produced with plants inoculated with individual *Azotobacter* followed by dual inoculum but without significancy between themselves.

As for the effect of interaction between Biomagic treatments and bacterial inoculation, in general the best values were recorded in leaves,shoots and roots of jojoba plants were recorded with spraying at the high rate of Biomagic (10g/l) combined with individual *Azotobacter* followed by using the high rate of Biomagic (10g/l) and inoculation with two bacterial mixture, but without significancy between themselves.

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تأثير المعاملة بالمنشطات والمخصبات الحيوية على النمو والتركيب الكيماوى لنبات الجوجوبا

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أجريت تجربة أصص وذلك لتتبع أثر المعاملة بالمنشط الحيوي بيوماجيك (٠، ٥، ٧,٥، ١٠جرام/لتر) والتلقيح البكتيري بالأزوتوباكتر ، الباسيلس أو خليط منهما على مقاييس النمو وكذا التركيب الكيماوى لنبات الجوجوبا . وقد أوضحت النتائج المتحصل عليها أن جميع المعاملات أدت إلى زيادة معنوية فى مقاييس النمو الخضرية مقارنة بمعاملة الكنترول وكانت أفضل المعاملات هى الرش بالبيوماجيك بتركيز ١٠جرام/لتر وذلك مع المخلوط البكتيري من الأزوتوباكتر والباسيلس. وبالنظر إلى مستوى الصبغات فى أوراق الجوجوبا فإن أعلى القيم كانت نتيجة المعاملة بالتركيز المتوسط من البيوماجيك (٧,٥ جرام/لتر) مع التلقيح المنفرد بالأزوتوباكتر. أعلى تركيز للكربوهيدرات فى الأوراق ، السوق، و الجذور سجلت نتيجة الرش بالبيوماجيك ١٠جرام/لتر مع التلقيح البكتيري المزدوج .

وقد زاد تركيز العناصر المعدنية فى الأوراق والسوق والجذور مقارنة بالكنترول كنتيجةللمعاملة بالبيوماجيك والتلقيح البكتيري ، وقد لوحظ أن رش النباتات بالتركيز الأعلى من البيوماجيك مع التلقيح البكتيري بالأزوتوباكتر أدى إلى الحصول على أعلى تركيز من النتروجين ، البوتاسيوم ، النحاس والمنجنيز فى أنسجة نباتات الجوجوبا يليها المعاملة بالتركيز الأعلى من البيوماجيك مع التلقيح المزدوج ولكن بدون فروق معنوية بين المعاملتين وعلى الجانب الآخر فإن المعاملة بالبيوماجيك بالتركيز الأعلى مع التلقيح بالباسيلس أدى إلى الحصول على أعلى تركيز من الفوسفور والحديد والزنك فى أنسجة الجوجوبا يليها المعاملة بالتركيز الأعلى من البيوماجيك مع التلقيح المزدوج ولكن بدون فروق معنوية بين المعاملتين .