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EFFECT OF BIOLOGICAL AND MINERAL FERTILIZATION ON GROWTH OF *White sapota* AND *Rose apple*

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ABSTRACT

A field experiment was conducted for two years (1999-2000) to evaluate two biofertilizers namely Microbeine and Phosphorene, two chemical fertilizers namely superphosphate; sulpher and combination between them as a basal applications on vegetative growth and chemical composition of white sapota and rose apple seedlings.

Data indicated that using biological and mineral fertilization are recommended in increasing all vegetative growth parameters i.e. plant height, number of leaves, stem diameter and leaf dry weight in comparison with tested other treatments. Furthermore, using 10gm/pot microbein plus 5gm/pot superphosphate surpassed all other used treatments in this respect.

INTRODUCTION

White sapota, Casimiroa edulis, fam. Rutaceae is a native of highlands of Mexico and introduced to subtropical areas. It's pulp is eaten which have a good source of vitamin C, carbohydrate and protein. It is propagated by seeds. *(Monadori, 1982* and *Roecklein, 1987).*

Rose apple, Eugenia Jambos (lam.) fam. Myrtaceae is evergreen trees, indigenous to subtropical rain forests of South East Africa. It is have attractive foliage, flowers and berries. The bark contains 7%tannin. Seeds have been used to treat some problems with diarrhea, dysentery and catarrh. Propagated from fresh seeds in spring or cuttings in summer. *Gerlinde, et al., (1999).*

Biofertilization, which is the use of living microorganisms such as : bacteria, fungi and blue-green algae is used to improve soil fertility by changing unavailable elements, such as nitrogen and phosphorus, into available forms of growing crops *(Boutrose, et al., 1987 & Elgala et al., 1995).*

Phosphorene is a biofertilizer product containing active microorganisms hydrolysing the insoluble phosphate into soluble one under high soil pH and greater percentage of calcium carbonate, consequently partially overcome the phosphate fixation *(Ahmed et al., 1997).*

Microbien is a multistrain biofertilizer composed of a set of microorganisms having a definite role in soil fertility. It increased plant resistance to diseases, stress, and achieves environmentally beneficial results *(Khasawneh & Doll, 1978, and Sundhakar & Gosh, 2000).*

Sulfur forms part of some amino acids and is crucial to the stability of the tertiary structure of enzymes and other proteins.

Application of biofertilizers i.e. microbein and phosphorene (Subba, Rao; 1984; Patil, 1985; Saber, *et al*., 1989; El-Ghandour, 1992; Haggag *et*

al., 1995; and Mansour, 1998) were favourable in improving vegetative growth and nutritional status of the strees.

This study was conducted to study the effect of superphosphate and sulpher as a mineral fertilizers and biofertilizer on the growth and the effect of combined inoculation on growth leaf nitrogen, phosphorus and chlorophyll contents of seedlings.

MATERIALS AND METHODS

This study was carried out at Faculty of Agriculture, Moshtohor, Qalyoubia Governorate during seasons of 1999 and 2000. Healthy and nearly uniform Casimiro edulis and Eugenia Jambos seedling of two months consists of 3-5 leaves and 7-10 cm height, grown in a sandy loam soil, planted in pots (20 cm diameter and 25cm high and filled with 2kg of sandy soil. Analysis or the investigated soil was carried out according to *Wilde and Vigot (1985)* and the data are shown in Table (1).

The following treatments were used :-

1. Control (untreated).
2. Soil addition of microbein 10g/pot.
3. Soil addition of phosphorine 15 g/pot.
4. Soil addition of single super phosphate 15% P (5g/pot).
5. Soil addition of sulpher 2g/pot

Table (1) : Analysis of the investigated soil.

Particle size distribution	
Sand %	68.14
Silt %	23.10
Clay %	8.76
Texture grade	sandy loam
pH (1 : 2.5 extract)	8.50
E.C (1 : 2.5 extract (mmhos/cm)	0.74
$CaCO_3$ %	6.0
Organic matter %	0.90
Available macronutrients	
Total N %	0.06
P (Olsen, ppm)	3.66
K (ammonium a cetate ppm)	160.56
Mg^{++}	2.66
$SO4^{--}$	1.72
DTPA extractable micronutrients ppm	
Fe	5.1
Mn	3.2
Cu	1.1
Zn	1.2

6. Soil addition of 10gm/pot microbein plus 5 gm/pot superphosphate.
7. Soil addition of 10 gm/pot ,icrobein plus 2 gm/pot sulpher.
8. Soil addition of 15 gm/pot phosporine plus 5gm/pot superphosphate.
9. Soil addition of 15gm/pot phosphrine plus 2gm/pot sulpher.

The biofertilizers source produced by general organization for Agric. Equalization Fund, Ministry of Agriculture. In all pots, soil was amended with 5gm/pot, Zn, Mn and Fe applied at the rate of 1 gm/pot in the form of zinc sulfate, manganese sulfate, an Fe-EDDHA, while Cu was added at the rate of 5gm/pot. The fertilizers were mixed with the soil before planting. Nitrogen fertilizer was applied as ammonium nitrate, at the rate of 50gm N/pot. Half of the nitrogen rate was applied after seedling emergence (two months after planting) while the other half was added after three months.

Measurements and Determination:

1.a. Vegetative Growth:

After 9 months from starting the treatments. Plant height (cm); leaf number/seedling, stem diameter (cm)/plant at 5 cm above soil level and dry weight/plant (g) were studied.

1.b. Leaf Samples:

The previously measured leaves were used also for chemical analysis. Thus, the leaves were wiped with a damp cloth, washed with 0.1.N. hydrochloric acid then rinsed in distilled water and oven dried at 70^{o}C till constant weight.

- Total chlorophyll contents (mg/g) fresh leaf as described by A.O.A.C. (1990).
- Total nitrogen using semi-micro Kjeldahl method as outlined by Pregl (1945).
- Phosphorus using spekol spectrophotometer at 882. U.V. according to the method described by Murphy and Riely (1962).

Generally all the previous treatments were arranged in a complete randomized block design with five replicates for each treatment. The obtained data of the present study were statistically analyzed according to the method described by (Mead *et al.*, 1993). The means of the tested treatments were differentiated with Duncan multiple range test at 5% level *Duncan (1955).*

RESULTS AND DISCUSSION

1. White sapota :

1.a. Vegetative Growth :-

It is clear from Table (2) that 10 gm/pot Microbein plus 5 gm/pot superphospate induced highly significant increase in plant height, number of leaves, stem diameter and plant dry weight followed by 10 gm/pot Microbein plus 2 gm/pot sulpher then 15 gm/pot phosphorine plus 5 gm/pot superphosphate in a descending order as compared with the other used treatments and the control. However, 10gm/pot Microbein plus 5 gm/pot

superphosphate increased significantly stem diameter and number of leaves which were duplicated in treated plants as compared with the control in both seasons. While, plant height and plant dry weight which increased four times over the control. On the other hand, significant differences were lacking between using 10 gm/pot Microbein plus 2 gm/pot sulpher and 15 gm/pot phosphorine plus 5 gm/pot superphospate treatments as number of leaves parameter was considered in the seasons of study.

In general, the above results indicated that biological and mineral fertilizers are recommended in increasing all vegatative growth parameters used in this study. These results are in harmony with the findings of *El-Ghandour, (1992), and Haggag et al., (1995).* They found that the application of biofertilizers i.e. microbein and phospharene were favourable in imrpoving vegetative growth and nutritional status of the trees.

1.b. Leaf Nutrient Contents :

Table (3) shows that all treatments under investigation maximized leaf nitrogen, phosphorus and chlorophyll contents during the two seasons. However, 10 gm/pot Microbein plus 5 gm/pot superphosphate treatment was the most promising treatment in increasing leaf nitrogen content during both seasons in comparison with other treatments. On the other hand no significantly in leaf nitrogen was noticed as using 10 gm/pot phosphorine, 5 gm/pot superphosphate and 2 gm/pot sulpher treatments were considered during the first season.

Dealing with leaf phosphorus content as affected by biological and mineral fertilizers, it is clear that 15 gm/pot phosphorine plus 5 gm/pot superphosphate during the first season and 10 gm/pot Microbein, plus 5 gm/pot superphosphate as well as 15 gm/pot phosphorine plus 5 gm/pot superphosphate treatments in the second season. Surpassed all other tested treatments in increasing leaf phosphorus content. However, significant increase of chlorophyll content occurred when 10 gm/pot Microbein plus 5 gm/pot superphosphate treatment was used in both seasons followed by 10 gm/pot Microbein plus 2 gm/pot sulpher then 15 gm/pot phosphorine plus 5 gm/pot superphosphate as well as 10 gm/pot Microbein during the first season as compared with the other used treatments and the control in a descending order. The above results some what go in line with the finding of *(Ceulemans et al., 1983)* recommended that fertilization with nitrogen and phosphorus for certain crops is a common practice for Egyptian soils to maintain high productivity. The environmental impacts gave researchers a strong reason to find a suitable alternative, clean and cheap source of fertilization *(Subba, Rao 1984; Saber et al., 1989 and Mansour, 1998).*

2. Rose apple :-

2.a. Vegetative Growth :-

It appears from Table (4) that all treatments under investigation maximized vegetative growth in both seasons as compared with the control. However, significant increase of vegetative growth occurred when 10 gm/pot Microbein plus 5 gm/pot superphosphate treatment was used followed by 10 gm/pot Microbein plus 2 gm/pot sulpher then 15 gm/pot phosphorine plus 5

gm/pot superphosphate as compared with the other used treatments and the control in a descending order of two seasons.

Meanwhile, 5 gm/pot superphosphate, 2 gm/pot sulpher and 15 gm/pot phosphorine plus 2 gm/pot sulpher treatment had depressive effect in this respect. Moreover, biological plus mineral fertilization surpassed other treatments in improving all parameters treatments under study of both seasons. These results coincided with those obtained by *(Khasawneh and Doll, 1978; Ceuleman, et al., 1983; Gadalla et al., 1993 and Elgala, et al., 1995).*

2.b. Leaf Nutrient Contents :-

It is quite evident from Table (5) that 10 gm/pot Microbein plus 5 gm/pot superphosphate treatment caused highly significant increase in leaf nitrogen content followed by 10 gm/pot Microbein plus 2 gm/pot sulpher then 15 gm/pot phosphorine plus 5 gm/pot superphosphate treatments as compared with the other used treatments and the control of both seasons. However, significant increase of leaf phosphorus content occurred when 15 gm/pot phosphorine plus 5 gm/pot superphosphate treatments was used in both seasons followed by 15 gm/pot phosphorine plus 2 gm/pot sulpher as well as 15 gm/pot phosphorine treatment in the second season as compared with the other used treatments and the control in a descending otder. On contrast, 10 gm/pot Microbein plus 5 gm/pot superphosphate treatment was the most promising treatment in increasing leaf chlorophyll content during the first and second seasons in comparison with other treatments. The lowest significant content of leaf chlorophyll was notices when the control or using 5 gm/pot superphosphate treatments were considered during the two seasons.

The above results somewhat go inline with the findings of (Boutros, *et al.*, 1987; Ahmed *et al.*, 1997 and Sudhakar and Gosh, 2000).

In conclusion, the combined effect of chemo and bio-additives is recommended mainly single elemental as sulpher application is considered.

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تأثير التسميد الحيوى والمعدنى على شتلات الكازميرو والبامبوزيا

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أجريت تجربتان بمزرعة كلية الزراعة بمشتهر خلال موسمى ١٩٩٩-٢٠٠٠ لدراسة تأثير استخدام بعض الأسمدة الحيوية مثل المبكروبين، الفوسفورين، وبعض الأسمدة المعدنية مثل سوبر فوسفات والكبريت سواء منفردة أو متحدة معاً، وذلك على صفات النمو الخضرى وبعض الخصائص الكيمائية مثل الكلوروفيل والتركيب الكيماوى المعدنى لأوراق شتلات كل من الكازميرو، البامبوزيا.

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى :

- أظهرت النتائج أن كل المعاملات أدت الى تحسين وزيادة عدد الأوراق أكثر من الكنترول سواء بالنسبة لشتلات الكازميرو أو البامبوزيا.
- كانت أحسن نتائج النمو الخضرى متمثلة فى ارتفاع الشتلات – عدد الأوراق لكل شتلة – قطر الساق، بالإضافة الى الوزن الجاف للأوراق، حيث وجد أن إضافة سماد السوبر فوسفات الى الميكروبين أعطت أفضل النتائج عن إضافة الميكروبين أو السوبر فوسفات الى الميكروبين أعطت أفضل النتائج عن إضافة الليميكروبين أو السوبر فوسفات كل بمفرده.
- تحسن النمو أيضاً عند استخدام الميكروبين مع الكبريت يليها الفوسفورين مع السوبر فوسفات ثم الميكروبين منفرداً ثم الفوسفورين + الكبريت وهكذا.
- اتحاد الأسمدة الحيوية مع المعدنية زاد من تحسن مستوى الكلوروفيل فى الأوراق. وكذلك فى النسبة المئوية للنتروجين فى الأوراق.
- النسبة المئوية للفوسفور فى الأوراق كانت كبيرة عند المعاملة باتحاد الفوسفورين مع السوبر فوسفات.
- كانت حالة النمو فى كلا النوعين متماثلة لحد ما.

Table (2) : Effect of biological and mineral fertilizers on plant height (cm), number of leaves and stem diameter (cm) of white sapota seedlings.

Treatment	Plant height (cm)		Number of leaves/seedling		Stem diameter (cm)		Dry weight (g)/plant	
	1999	2000	1999	2000	1999	2000	1999	2000
Control	29.22 H	29.78 G	16.00 F	22.67 E	3.87 G	3.70 G	2.46 H	2.40 H
10 gm/pot Microbein	49.33 D	51.33 D	29.67 D	34.33 C	6.00 D	5.70 D	3.67 D	3.65 D
15 gm/pot phosphorine	35.33 F	35.67 F	42.33 E	29.33 D	4.97 F	4.87 F	3.33 F	3.00 F
3 gm/pot superphosphate	31.33 G	30.00 G	42.33 E	29.33 D	4.88 F	4.73 F	2.95 G	2.93 G
2 gm/pot sulpher	25.00 I	23.33 H	24.00 E	28.00 D	4.87 F	5.10 E	2.00 I	2.20 HI
10 gm/pot Microbein + 5 gm/pot superphosphate	118.7 A	119.00 A	39.67 A	40.33 A	8.17 A	7.78 A	9.63 A	9.67 A
10 gm/pot Microbein + 2 gm/pot sulpher	86.89 B	86.67 B	37.33 B	39.78 AB	7.27 B	6.87 B	7.37 B	7.46 B
15 gm/pot phosphorine + 5 gm/pot superphosphate	57.67 C	60.00 C	33.67 C	39.67 AB	6.67 C	6.57 C	5.10 C	5.26 C
15 gm/pot phosphorine + 2 gm/pot sulpher	43.00 E	42.33 E	28.00 D	38.00 B	5.53 E	5.81 D	4.32 E	4.36 E

Table (3) : Effect of biological and mineral fertilizers on some chemical constituent and chlorophyll leaves of white sapota seedlings.

Treatment	N%				P%				Chlorophyll mg/100 gm F.W			
	1999		2000		1999		2000		1999		2000	
Control	1.98	E	2.11	E	0.13	G	0.16	G	30.90	I	31.33	H
10 gm/pot Microbein	2.55	C	2.34	CD	0.17	EF	0.20	F	40.10	C	38.96	D
15 gm/pot phosphorine	2.39	D	2.32	CD	0.24	B	0.27	B	36.94	F	35.69	F
3 gm/pot superphosphate	2.30	D	2.27	D	0.23	C	0.25	C	35.84	G	37.43	E
2 gm/pot sulpher	2.29	D	2.23	D	0.18	DE	0.23	D	34.37	H	34.70	G
10 gm/pot Microbein + 5 gm/pot superphosphate	2.81	A	2.78	A	0.24	B	0.29	A	45.20	A	44.66	A
10 gm/pot Microbein + 2 gm/pot sulpher	2.73	AB	2.46	B	0.17	F	0.21	E	42.57	B	42.23	B
15 gm/pot phosphorine + 5 gm/pot superphosphate	2.63	BC	2.56	B	0.26	A	0.29	A	41.10	C	39.84	C
15 gm/pot phosphorine + 2 gm/pot sulpher	2.54	C	2.40	C	0.19	D	0.23	D	38.17	E	38.66	D

Table (4) : Effect of biological and mineral fertilizers on plant height (cm), number of leaves and stem diameter (cm) and leaf dry weight (g) of rose apple seedlings.

Treatment	Plant height (cm)		Number of leaves/seedling		Stem diameter (cm)		Dry weight (g)/plant	
	1999	2000	1999	2000	1999	2000	1999	2000
Control	47.00 G	45.33 I	14.67 G	21.67 F	3.63 I	3.50 G	3.67 G	3.60 G
10 gm/pot Microbein	69.33 D	65.00 D	21.67 D	30.00 CD	6.53 D	5.53 D	5.13 D	5.21 D
15 gm/pot phosphorine	63.33 E	58.44 F	20.00 DE	26.44 E	5.27 F	5.01 E	4.67 E	4.69 E
3 gm/pot superphosphate	57.00 F	55.33 G	17.67 F	26.00 E	4.94 G	4.27 F	4.33 F	4.30 F
2 gm/pot sulpher	55.00 F	49.33 H	17.00 F	23.00 F	4.60 H	4.27 F	8.33 A	8.61 A
10 gm/pot Microbein + 5 gm/pot superphosphate	107.3 A	97.33 A	33.56 A	44.67 A	11.29 A	9.58 A	7.33 C	7.36 C
10 gm/pot Microbein + 2 gm/pot sulpher	87.00 B	74.00 B	28.00 B	36.67 B	9.41 B	8.53 B	7.67 B	7.68 B
15 gm/pot phosphorine + 5 gm/pot superphosphate	78.33 C	68.67 C	24.33 C	31.56 C	7.80 C	7.56 C	4.00 F	4.20 E
15 gm/pot phosphorine + 2 gm/pot sulpher	56.89 F	62.33 E	19.67 E	28.67 D	6.07 E	5.43 D	4.23 F	4.60 EF

Table (5) : Effect of biological and mineral fertilizers on some chemical constituent and chlorophyll of rose apple seedlings.

Treatment	N%		P%		Chlorophyll mg/100 gm F.W	
	1999	2000	1999	2000	1999	2000
Control	2.10 G	2.10 G	0.12 E	0.12 D	32.5 I	33.00 I
10 gm/pot Microbein	2.43 D	2.41 D	0.14 D	0.14 C	41.13 D	41.66 D
15 gm/pot phosphorine	2.26 FE	2.28 FE	0.15 C	0.15 B	37.40 F	38.50 F
3 gm/pot superphosphate	2.21 F	2.22 F	0.13 DE	0.14 C	36.33 G	37.50 G
2 gm/pot sulpher	2.22 F	2.25 F	0.14 D	0.13 C	35.60 H	36.27 H
10 gm/pot Microbein + 5 gm/pot superphosphate	2.86 A	2.87 A	0.16 B	0.16 B	52.56 A	46.70 A
10 gm/pot Microbe + 2 gm/pot sulpher	2.68 B	2.66 B	0.13 DE	0.13 C	45.78 B	44.60 B
15 gm/pot phosphorine + 5 gm/pot superphosphate	2.53 C	2.55 C	0.19 A	0.18 A	42.83 C	43.63 C
15 gm/pot phosphorine + 2 gm/pot sulpher	2.33 E	2.34 E	0.16 B	0.16 B	38.97 E	41.20 E