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PERFORMANCE OF GRAND NAINE BANANA PLANTS TO BIOFERTILIZATION

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ABSTRACT

During 2001/ 2002 and 2002/ 2003 seasons, three biofertilizers namely Biogen, Microbene and Nitrobene, each at 100 to 300 g / plant aside mineral N source at the fixed rate of N i.e. 500g / plant were tested for their effect on growth and fruiting of Grand Naine banana plants.

Results showed that biofertilization with Biogen, Microbene and Nitrobene each at 100 to 300 g / plant , in descending order was effective in enhancing growth characters, leaf contents of N, P and K, bunch weight, weights of hand and finger , pulp/ peel ratio , total soluble solids % , total and reducing sugars % and in decreasing the total acidity compared to unbiofertiliztion. There was unfavourable effects on growth characters, yield and fruit quality with increasing the amount of biofertilizers from 200 to 300 g/ plant. Percentage of starch did not change with the present treatments.

It is necessary for biofertilizing Grande Naine banana plants with Biogen at 200g and 300 g N in any mineral source / plant to improve the yield and fruit quality.

INTRODUCTION

Recently, biofertilization is considered an important tool to enhance the yield of the prime and popular banana cv. Namely Grand Naine and it becomes a positive alternative to chemical fertilizers. Biofertilizers are safe for human, animal and environment and using them was accompanied with reducing the great pollution occurred in our environment as well as for producing organic foods for export. They are favourable in increasing N fixation, the availability and uptake of nutrients and stimulation of natural hormones (Subba – Rao , 1984 and Kannaiyan , 2002)

Previous studies emphasized the great benefits for using biofertilizers as a partial substitute for mineral N sources on growth , nutritional status of plants , yield, as well as physical and chemical characters of the fruits (Declerek *et al.,* 1994; Acosta *et al.,* 1995; Declerek *et al.,* 1995; Alonso-Reyes *et al.,* 1995; Dibut et al., 1996; Tiwary *et al.,* 1998; Smith, 1998; Soliman , 2001; Suresh and Hasan , 2001; Ahmed *et al.,* 2003; Ali, 2004; and Sayed-Shren, 2004).

This study was established to throw some light on the effect of three biofertilizers namely Biogen, Microbene and Nitrobene on growth, yield and fruit quality of Grande Naine bananas.

MATERIALS AND METHODS

This work was performed during two successive seasons of 2001/ 2002 and 2002 / 2003 seasons on Grand Naine banana plants grown in a private orchard situated at Samalout district , El- Minia Governorate , where the soil is silty clay. The experiment was carried out on the third and fourth

ratoons. Planting distance was 3.5 x 3.5 meters and three suckers (offshoots) were selected per each stool for fruiting in the following seasons in addition to the other plants that will give the crop of the current seasons.

Analysis of the tested soil was carried out according to Wide *et al.*, (1985) and the obtained data are shown in Table (1):

Table (1): Analysis of the tested soil:

Silt %	: 55.0	O.M. %	: 1.95
Clay %	: 25.0	$CaCO_3$	: 1.25
Sand %	: 20.0	Total N %	: 0.1
Texture	: silty clay	Available P (ppm, Olsen)	: 10.0
E.C.(1: 2.5 extract) (mmhos/cm)	: 0.71	Available K (ppm. Ammonium acetate)	: 396.0
pH (1 : 2.5 extract)	: 7.2		

The experiment included the following ten treatments from biofertilizers and mineral source of nitrogen (at fixed rate of N namely 500 g N/ plant according to Sayed –Shren , 2004)

1-using mineral source of N only at 500 g N / plant.
2-Using 100 g Biogen + 400 g N / plant via mineral source.
3-Using 200 g Biogen + 300 g N / plant via mineral source.
4- Using 300 g Biogen + 200 g N / plant via mineral source.
5- Using 100 g Microbene + 400 g N / plant via mineral source.
6- Using 200 g Microbene + 300 g N / plant via mineral source.
7- Using 300 g Microbene + 200 g N / plant via mineral source.
8- Using 100 g Nitrobene + 400 g N / plant via mineral source.
9- Using 200 g Nitrobene + 300 g N / plant via mineral source.
10- Using 300 g Nitrobene + 200 g N / plant via mineral source.

Each treatment replicated three times two stools per each. Sixty stools (180 plants plus the same number of suckers) were selected for achieving this trial . The randomized complete block design was used.

Actual amount of N received by each plant was 500 g N / plant /year. Mineral N source was ammonium sulphate (20.6 %) , Mineral N source was added at 14 equal batches and broadcasted on the soil surface at two weeks intervals from April till October. The three fresh and activated biofertilizers namely Biogen, Microbene and Nitrobene at the prementioned amounts were added once (1st week of April) in 10 cm below soil surface and in a circle of 50 cm. diameter around the plants.

After the emergence of the inflorescences (1st week of August in both seasons , the following growth measurements were determined pesudostem height (cm) and girth (cm), as well as total leaf / plant (according to Jain and Misra, 1966)

For determining the leaf N, P and K, a leaf sample from each plant was taken at a 15 cm strip from each side of the midrib in the middle of the blade of the third leaf from the top of the plant at shooting stage as recommended by Garcia *et al.*, (1977). Determinations were carried out on dry weight basis.

At harvesting tiem (1st week of December in both seasons) when the fingers reached the full mature stage, bunch weight per plant (in kg) was recorded . Also average hand weight (kg) registered. Six hands were taken from the base, middle and distal end of each bunch as a composite sample for determine physical and chemical properties of the fruits. Hands were arrested in closed wooden boxes with a glass surface to achieve artificial ripening and after the fingers ripened, the following determinations were carried out.

1- Average finger weight (g).
2- Average weight of pulp and peel to calculate pulp/peel ratio.
3- Percentage of total soluble solids.
4- Percentages of reducing and total sugars were determined according to Lane and Eynon volumetric method that outlined in A O A C (1985)
5- Percentage of total acidity (as g malic acid / 100 g pulp) (according to A O A C , 1985).
6- Percentage of starch (A O A C , 1985)

All the obtained data were tabulated and subjected to analysis of variance. Method of new L.S. D. was used to differentiate various treatment means at 5% of probility (Mead *et al.*, 1993).

RESULTS AND DISCUSSION

1-Growth characters:

It is clear form the data in Table 2 that varying biofertilizer treatments had a significant effect on growth characters. Application of Biogen , Microbene and Nitrobene at 100 to 300 g / plant in combined with mineral source of N at 200 to 400 g N / plant significantly stimulated the three growth characters namely height and girth of pseudostem and total leaf compared to unbiofertilization or using mineral N source only.

The maximum values were detected on plants received Biogen, Microbene and Nitrobene, in descending order . Increasing levels of each biofertilizer from 100 to 200 g / plant was followed by a gradual promotion on such growth characters. However, these growth characters tended to reduce with increasing the rate of each biofertilizer from 200 to 300 g / plant. The maximum values were detected on the plants biofertilized with 200 g Biogen plus 300 g N in any mineral source / plant. Unbiofertilizing the plants gave the minimum values. These results were true in both seasons.

The beneficial effect of the biofertilizers on increasing the availability of nutrients consequently improving cell division could explain the present results. In addition the important role of these biofertilizers in fixation of N and the secretion of natural hormones and antibiotics could give another explanation.

These results are in harmony with those obtained by Ahmed *et al.*, (2003) and Ali (2004).

2-Percentages of N, P and K in the leaves.

It is evident from the data in Tables 2 and 3 that supplying Grand Naine banana plants with the three bioferetilizers along with N in mineral source significantly was responsible for enhancing percentages of N, P and K in the leaves compared to using N completely via mineral source. In ascending order , application of Nitrobene , Microbene and Biogen was accompanied with increasing these essential nutrients.

Increasing the level of each biofertilizer from 100 to 200 g / plant was followed by significant promotion on these nutrients. Significant reduction on these elements was detected due to raising levels of biofertilizer from 200 to 300 g/ plant. Amending the plants with 200 g Biogen plus 300 g N / plant via any mineral source gave the maximum values. The minimum values were detected on the plants did no receive any biofertilzers. The same trend was observed in both seasons.

The important role of biofertilizers in reducing soil pH and increasing organic matter content surely reflected on enhancing the availability of these nutrients.

Similar results were declared by Declerek *et al.*, (1994) , Acoista *et al.*, (1995), Alono- Reyes *et al.*, (1995) and Smith (1998).

3-Bunch weight as well as hand weight:

As shown in Table 3, weights of bunch and hand were positively affected by biofertilizing Grand Naine banana plants with the three biofertilizers compared to unbiofertilization. Unbiofertilization significantly reduced weights of bunch and hand compared to biofertilization. Using Biogen, Microbene and Nitrobene at 100 to 300 g / plant, in descending order was very effective in improving weights of bunch and hand.

The best biofertizer in this connection was Biogen followed by Microbene. The promotion was associated with increasing the amounts of each biofertilizer from 100 to 200 g /plant. There was a significant reduction on weights of bunch and hand with increasing the amount of each biofertilizer from 200 to 300 g / plant or with reducing the amount of N applied via mineral source from 300 to 200 g/plant. Therefore, the maximum amount of biofertilizers must be used was 200 g / plant aside 300 g N / plant on mineral N source. The best results with regard to weights of bunch and hand were obtained due to carrying out biofertilization with Biogen at 200 g / plant plus 300 g N / plant in any mineral source. Under such promising treatment, yield / plant reached 29.9 and 30.0 kg in both seasons , respectively. Unbiofertilization gave yields reached 24.1 and 24.2 kg in both seasons, respectively. The same trends was detected in 2001/ 2002 and 2002/ 2003 seasons.

The improving effect of biofertilization on growth and nutritional status of plants could give an explanation for their positive action on the yield.

These results are in harmony with those obtained by Tiwary *et al.*, (1998), Soliman (2001) and Suresh and Hasan (2001).

4-Fruits quality:

It is clear from the data in Tables 3 and 4 that biofertilization by using Biogen, Microbene or Nitrobene asid from mineral N source was significantly favourable for enhancing fruit quality of Grand Naine banana in terms of

Table (2): Effect of some biofertilizers on some growth characters and leaf content of N and P of Grand Naine banana plants during 2001/ 2002 and 2002/ 2003 seasons.

Biofertilization treatments	Pseudostem height (cm)		Pseudostem girth (cm)		Total leaf area (m^2)		Leaf N %		Leaf P %	
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003
Using mineral source only (500 g N/ plant)	288.1	291.2	81.0	82.3	33.1	35.0	2.41	2.50	0.16	0.18
100 g Biogen + 400 g N via M.S.	311.0	321.0	94.0	98.0	39.0	41.0	2.82	2.44	0.35	0.35
200 g Biogen + 300 g N via M.S.	318.5	326.0	96.3	99.3	40.5	42.3	2.95	2.99	0.39	0.40
300 g Biogen + 200 g N via M.S.	316.0	222.3	94.0	97.4	39.0	41.0	2.88	2.95	0.36	0.36
100 g Microbene + 400 g N via M.S.	301.0	309.0	88.0	91.0	37.0	39.0	2.69	2.81	0.28	0.29
200 g Microbene + 300 g N via M.S.	305.0	315.0	91.0	94.3	39.0	40.5	2.89	2.91	0.31	0.33
300 g Microbene + 200 g N via M.S.	301.2	311.0	88.6	93.0	37.5	39.4	2.80	2.86	0.27	0.30
100 g Nitrobene + 400 g N via M.S.	292.3	296.0	82.2	85.5	35.0	36.8	2.50	2.62	0.20	0.22
200 g Nitrobene + 300 g N via M.S.	296.0	301.0	85.0	88.0	36.3	38.0	2.67	2.74	0.25	0.26
300 g Nitrobene + 200 g N via M.S.	293.1	297.1	83.5	86.3	35.0	37.0	2.60	2.68	0.22	0.23
New L.S.D. at 5 %	2.1	3.0	1.1	1.0	1.0	1.0	0.6	0.5	0.2	0.3

M.S. = Mineral Source of N

Table (3) : Effect of some biofertilizers on leaf content of k, bunch weight (kg) , hand weight (kg) finger eight (g) and pulp/ peel ratio of Grand Naine banana plants during 2001/ 2002 and 2002/ 2003 seasons

Biofertilization treatments	Leaf K %		Bunch weight (kg)		Av hand weight (kg)		Av. Finger weight (g)		Pulp/ peel ratio	
	2001/ 2002	2002 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003
Using mineral source only (500 g N/ plant)	2.11	2.00	24.1	24.2	1.69	1.55	95.2	96.3	1.6	1.7
100 g Biogen + 400 g N via M.S.	0.55	2.28	28.9	29.1	2.65	2.29	112.0	112.0	2.6	2.8
200 g Biogen + 300 g N via M.S.	2.61	2.40	29.9	30.0	2.85	2.60	115.0	115.0	2.8	2.9
300 g Biogen + 200 g N via M.S.	2.55	2.32	29.2	29.1	2.60	2.45	113.0	112.0	2.5	2.6
100 g Microbene + 400 g N via M.S.	2.33	2.22	27.1	27.1	2.18	2.97	106.0	106.0	2.2	2.6
200 g Microbene + 300 g N via M.S.	2.41	2.32	28.0	28.0	2.41	2.22	109.0	110.0	2.5	2.8
300 g Microbene + 200 g N via M.S.	2.36	2.26	27.3	27.0	2.30	2.11	107.0	107.0	2.3	2.6
100 g Nitrobene + 400 g N via M.S.	2.21	2.10	25.0	25.2	1.89	1.70	98.3	99.0	1.8	2.0
200 g Nitrobene + 300 g N via M.S.	2.31	2.21	26.2	26.3	2.00	1.92	102.3	105.0	2.0	2.3
300 g Nitrobene + 200 g N via M.S.	2.25	2.11	25.0	25.5	1.88	1.80	100.0	102.0	1.8	2.0
New L.S.D. at 5 %	0.5	0.4	0.5	0.8	0.10	0.11	1.8	2.0	0.2	0.2

M.S. = Mineral Source

Table (4): Effect of some biofertilizsers on some fruit chemical characters of Grande Naine banana plants during 2001/ 2002 and 2002/ 2003 seasons.

Biofertilization treatments	T.S.S. %		Total sugars %		Reducing sugars %		Total acidity %		Starch %	
	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003	2001/ 2002	2002/ 2003
Using mineral source only (500 g N/ plant)	20.0	19.6	17.7	18.0	7.1	7.3	0.511	0.531	1.96	2.00
100 g Biogen + 400 g N via M.S.	22.2	22.0	20.7	20.9	9.0	8.5	0.360	0.391	1.90	1.91
200 g Biogen + 300 g N via M.S.	22.9	22.8	21.4	21.0	9.4	9.0	0.340	0.355	1.90	1.92
300 g Biogen + 200 g N via M.S.	22.8	22.4	21.1	20.6	9.0	8.8	0.345	0.360	1.92	1.93
100 g Microbene + 400 g N via M.S.	21.1	21.3	19.9	19.5	8.1	8.2	0.421	0.430	1.92	1.91
200 g Microbene + 300 g N via M.S.	22.0	22.0	20.5	20.0	8.5	8.0	0.391	0.392	1.90	1.91
300 g Microbene + 200 g N via M.S.	21.8	21.6	20.1	19.6	8.3	7.7	0.396	0.395	1.91	1.90
100 g Nitrobene + 400 g N via M.S.	20.5	20.0	18.2	18.5	7.6	7.8	.0.481	0.501	1.94	1.94
200 g Nitrobene + 300 g N via M.S.	20.9	20.6	19.3	19.1	7.9	8.3	0.450	0.466	1.91	1.92
300 g Nitrobene + 200 g N via M.S.	20.6	20.3	18.8	18.8	7.7	8.1	0.461	0.470	1.92	1.91
New L.S.D. at 5 %	0.2	0.3	0.3	0.2	0.2	0.2	0.025	0.031	NS	NS

M.S. = Mineral Source

increasing finger weight, pulp/ peel, total soluble solids %, total and reducing sugars % and decreasing total acidity % compared to unbiofertilization. Using Biogen, Microbene and Nitrobene had no significant effect on starch %. The promotion was associated with employing Biogen, Microbene and Nitrobene, in descending order. There was a remarkable promotion on fruit quality with increasing the role of each biofertilizer from 100 to 200 g / plant. Unfavourable effects on fruit quality were detected when the amount of each biofertilizer was increased from 200 to 300 g / plant. Using 200 g Biogen/ plant plus 300 g N / plant in mineral N source gave the best results with regard to fruit quality. Unacceptable effect on fruit quality was recorded on plants unbiofertilized on those plant received the recommended rate of N completely via mineral source. Similar findings ere obtained in both seasons.

The improving effect of biofertilizers on the biosynthesis of carbohydrates could explain the present results.

These results are in harmony with those obtained by Declerek *et al.*, (1995); Soliman (2001) and Ahmed *et al.*, (2003).

As a conclusion, biofertilization of Grand Naine banana plants with 200 g Biogen plus 300 g N in any mineral source / plant suggested to be very beneficial for improving yield and fruit quality.

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سلوك نباتات الموز الجراندنان للتسميد الحيوى

على عبد العزيز جبارة

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تم خلال موسمى ٢٠٠١/ ٢٠٠٢ ، ٢٠٠٢/ ٢٠٠٣ اختبار تأثير ثلاثة أسمدة حيوية هى البيوجين والميكروبين والنيتروبين بمعدل ١٠٠- ٣٠٠ جرام للنبات جنبا الى جنب مع مصدر معدنى للتسميد النيتروجينى وذلك بمعدل ثابت هو ٥٠٠ جرام للنبات الواحد وذلك على النمو والإثمار لنباتات الموز الجراندنان.

أشارت نتائج الدراسة الى أن التسميد الحيوى باستخدام البيوجين والميكروبين والنيتروبين بمعدل ١٠٠ الى ٣٠٠ جرام للنبات مرتبة ترتيبا تنازليا كان فعالا فى تحسين النمو الخضرى ومحتوى الورقة من عناصر النيتروجين والفوسفور والبوتاسيوم، ووزن السوباطة ووزن الكف والصباع والنسبة ما بين اللب الى القشرة، النسبة المئوية للمواد الصلبة الذائبة الكلية والنسبة المئوية للسكريات الكلية والمختزلة وفي تقليل النسبة المئوية للحموضة وذلك بالمقارنة بعدم التسميد الحيوى وكانت هناك تأثيرات غير مرغوبة على صفات النمو الخضرى والمحصول وخصائص الثمرة عند زيادة الكمية المستخدمة من الأسمدة الحيوية من ٢٠٠ الى ٣٠٠ جرام للنبات ولم تتأثر النسبة المئوية للنشا بالمعاملات تحت الدراسة.

يكون من الضرورى التسميد الحيوى لنباتات الموز الجراندنان باستخدام البيوجين بمعدل ٢٠٠ جرام بالاضافة الى ٣٠٠ جرام نيتروجين معدنى للنبات .