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IMPACT OF BIOFERTILIZER ON GROWTH AND YIELD OF BANANA WILLIAMS IN THE SANDY SOIL AT NUBARIA REGION.

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ABSTRACT

This investigation was carried out on two successive seasons of 2002/3 and 2003/4 on Williams banana grown in sandy soil under drip irrigation system receiving different rates of nitrogen fertilizer. The annual rates per plant were 200,400 and 600 g ammonium nitrate with or without HALEX biofertilizer.The tested rates were divided into 84 equal doses during the year (12 doses/month) and were added as solution by fertigation.HALEX was added once in the middle of April as 5 L/ plant .

The best results with regard to vegetative growth and yield were obtained due to fertilizing Williams banana plants with N at 600g ammonium nitrate / plant plus 5L. HALEX biofertilizer per plant per year.

INTRODUCTION

In Egypt a few investigations are available on biofertilizer applications on banana. Musa plants require high amounts of plant nutrients to maintain high production and good fruit quality.Excessive use of mineral fertilizers is expensive.Nitrogen has the dominating influence on vegetative growth and productivity.

Mayaz and Salem (1992) studied the effect of some nitrogen fertilizers treatments on the growth of banana (Musa cavendisihii Lamb.) in sandy soil during three successive seasons on growth .They found that inorganic nitrogen applied at monthly intervals (4-8 times/year), and 25-50% organic nitrogen (farmyard manure) once a year in December resulted in earlier flowering and bunch maturation under drip irrigation system in sandy soil. Tiwary *et al.*, (1998) studied the effect of inoculation with Azotoacter and Azospirillum on growth of banana cv-Giant grown with different N rates. They concluded that inoculation of sucker and soil with Azospirillum resulted in maximum plant height and leaf size in plants receiving 50% of the recommended N dose. Fernandez-Falcon *et al.*,(1998) studied the effect of RETFLOPX 357 a commercial mixture of microorganisms including nitrogen fixing bacteria,humus producing bacteria, moulds and algae in a liquid suspension on banana plants cv.Dwarf cavendish, found that the pseudostem circumference was increased.

The aim of this investigation is to decrease the cost production, to obtain high fruit production, to save chemical nitrate fertilizers, and also to keep the environment clean.

MATERIALS AND METHODS

Field experiment :

This investigation was carried out during the two successive seasons of 2002/2003 and 2003/2004 on banana private garden at El-Bustan, Nubaria region, Behiera Governorate .

Physical, chemical, fertility and irrigation water analysis of the tested soil were investigated according to Page *et al.*, (1982) and the data are given in Table (1) ABC. The experimental banana plantation was of the Williams cultivar (Giant cavendish AAA sub group) .Suckers were planted in March 2001, and at 3 × 4m. apart .Three off-shoots were selected for each mat during the summer of 2001.

Fertilization :

1- Ammonium nitrate commercial fertilizer (33.5% N) was applied at three different levels 200, 400 and 600 g per plant divided into 84 doses, 3 doses per week were applied starting first of April to the last week of October.

2- HALEX biofertilizer was supplied by Prof. Dr. M.G. Hassouna, plant pathology Dept., Fac. of Agric., University of Alexandria . The biofertilizer is made up of mixture of dinitrogen fixing bacteria Azotobacter spp, Azospirillum sp., and Klebsiella sp., engineered for higher N-fixtion. The biofertilizer was used as a suspension at the level 500 g/100 L. water and was added as 5 L per plant in the middle of April .The drip irrigation system, with two lines per single row and promising micro flapper emitters were used following the method of Ibrahim, (1993) and Ibrahim 2003. Well water of 135 m deep was used and the nutrient fertilizers were injected in the irrigation system.

Vegetative growth and flowering parameters:

At bunch shooting stage, the ultimate length of the pseudostem in cm from the soil surface to the junction of the terminal petiole of the top-most leaf on the plant was recorded . Pseudostem girth was also measured at 10 cm above soil surface. Number of green leaves on each experimental plant was counted at bunch shooting stage. Number of suckers per plant was recorded from first of April to the end of June . Assimilation area of each plant was determined according to the following equation :

Assimilation area/plant (cm2) = Av. leaf area x number of green leaves/plant.

The area of each leaf was calculated according to the following equation.

Leaf area = length x width x 0.86 (Obiefuna and Ndubizu, 1979)

The time from bunch shooting to date of harvesting in days was also computed .

Bunch characteristics:

At harvesting, the bunch weight (kg), number of hands/bunch, and number of fingers/bunch were counted.

Finger parameters:

The finger weight in (g), finger length in (cm) and finger diameter in (cm) at the middle part of the finger was recorded .

A randomized complete blocks design (RCBD) with four replicates was used to conduct the experiment . Data were statistically analyzed according to Steel and Torrie (1982). Means were compared by using (L.S.D.) at 5% probability level as described by Waller & Duncan (1969).

RESULT AND DISCUSSION

1- Banana vegetative growth and flowering :

The data in Tables (2&3) show that during both experimental seasons, banana plants responded positively to Ammonium nitrate and HALEX biofertilizer.

The pseudostem length increased from 246,25 cm to 275,9 cm with increasing nitrogen levels from 200g to 600g/plant and from 249,00 cm to 283,00 cm in the first and second seasons, respectively. While, the length increased from 256.00 cm to 265,00 cm and from 259,83 cm to 267,58 cm due to the application of biofertilizer in the first and second seasons. Respectively. Pseudostem girth, number of suckers, number of green leaves and assimilation area revealed similar trend during the two seasons. The highest concentration of nitrogen and bioferilizer gave the best vegetative growth.

Many investigators referred to the promotion which occurred in growth due to application of biofertilizer (N2 – fixers) might be attributed to its effect on increasing the availability of N-fixed and the higher N-uptake by plants (Subba Rao, 1984). The obtained results are in accordance with those Tiwary *et al.* (1998) on banana cv. Giant Cavendish, Abd El-Naby (2000) on Maghrabi banana , El-Shenawi (2000) , Abd El-Aziz (2002) and Ahmed *et al.* (2003) on banana cv. Williams and Hammam (2003) on Cavendish & Williams banana .

2- Time of bunch shooting .

The shortest period from ifloresence to harvest (bunch shooting) was observed in plants which received the highest ammonium nitrate and biofertilizer (Tables 4&5), these results are in agreement with those obtained by Abou-Aziz *et al.* (1987), Abd El-Kader *et al.* (1990) and El-Shenawi (2000).

3- Bunch parameters:

The data in Tables (4&5) indicate that application of ammonium nitrate and biofertilizer lead to signigicant increase in bunch weight, number of hands per bunch and number of finger per bunch in both seasons.

The present results are in agreement with obtained by Jeeva *et al.* (1988) who found that the bunch weight of banana cv. Poovan (AAB) was increased by 8,2% plants inoculated control receiving mineral nitrogen only . Also, those results are in agreement with those of Fernandez – Falcon *et al.* (1998) who found that the number of fingers / hand for banana cv. Dwarf Cavendish was increased by using of RETFLOPX 357 (a commercial mixture of microorganisms)., Tiwary *et al.* (1998) on banana cv. Giant, Chezhiyan *et al.* (1999) on banana cv. Virupakshi, El-Shenawi (2000) and Abd El-Aziz (2002) working on banana cv. Williams and Hammam (2003) on banana Cavendish & Williams .

Table: (1) ABC

A: Soil physical and chemical analysis of the experimental soil.

Soil depth cm	$CaCo_3$ %	EC ds/m	pH 1:2.5	Soluble cations (meq/l)				Soluble anions (meq/l)				Mechanical analysis			Soil Texture
				Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	So_4^{2-}	Sandy	Silt %	Clay %	
30-0	1.13	1.46	8.1	3.59	1.19	8.08	1.74	–	1.69	8.77	4.14	86.0	7.4	6.6	Sandy
60-30	1.65	1.55	8.24	3.98	1.31	8.25	1.96	–	1.89	9.11	4.50	84.0	8.8	7.2	Sandy
90-60	2.03	1.63	8.32	4.32	1.46	8.42	2.2	–	2.03	9.50	5.10	82.0	9.6	8.4	Sandy

B-Soil fertility of the experimental soil

Soil depth cm	O.M. %	Total N%	Available		DTPA. Extract (ppm)		
			P %	K%	Zn	Fe	Mn
30-0	0.23	0.04	3.13	58.18	0.35	2.79	0.64
60-30	0.19	0.03	2.05	66.57	0.28	2.38	0.58
90-60	0.14	0.02	1.13	71.72	0.22	1.87	0.54

C- Analysis of irrigation water sample

EC Ds/m	pH	Soluble cations (meq/l)				Soluble anions (meq/l)				B
		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO^{-}	Cl^{-}	SO_4^{2-}	PPm
1.16	8.4	2.16	2.29	6.18	0.97	–	2.45	7.97	1.18	0.59

Table (2): Effect of mineral-N and biofertilizer plus the supplements on vegetative growth parameters of Williams banana cultivar in newly reclaimed sandy soil (first season, 2002/2003).

Treatments	Pseudosten				No. of suckers	% increase	No. of green leaves	% increase	Assimilation area (m^2/plant)	% increase
	Length (cm)	% increase	Girth (cm)	% increase						
Nitrogen:										
N1(200g)	246,25^c		62,75^c		2,50^c		11,25^c		16,65^c	
N2(400g)	259,50^b	5.38	71,87^b	14,53^b	4,25^b	70	13,38^b	18,93	21,40^b	28,53
N3(600g)	275,88a	12,03	84,13a	34,07	6,50a	160	14,75a	31,10	25,36a	52,31
L.S.D. at 5%	4,748		2,288		1,112		0,861		1,192	
Biofertilizer:										
Without Bio.	256,00^b		71,00^b		3,75^b		12,50^b		20,09^b	
With Bio.	265,08a	3,55	74,83a	5,39	5,08a	35,47	13,75a	10,00	22,18a	10,40
L.S.D at 5%	3,877		1,868		0,908		0,703		0,974	

Table (3): Effect of mineral-N and biofertilizer plus the supplements of Williams banana cultivar in newly reclaimed sandy soil (second season, 2003/2004)

Treatments	Pseudosten				No. of suckers	% increase	No. of green leaves	%increase	Assimilation area (m^2/plant)	% increase
	Length (cm)	% increase	Girth (cm)	% increase						
Nitrogen:										
N1(200g)	249,00^c		63,13^c		2,50^c		11,75^c		17,24^c	
N2(400g)	259,13^b	4,07	72,25^b	14,45^b	4,00^b	60,00	13,25^b	12,77	21,65^b	25,64
N3(600g)	283,00a	13,65	83,75a	32,66	7,13a	185,2	15,25a	29,79	26,04a	51,04
L.S.D. at 5%	4,445		2,055		0,938		0,939		0,955	
Biofertilizer:										
Without Bio.	259,83^b		71,25^b		3,91^b		12,58^b		20,24^b	
With Bio.	267,58a	2,98	74,83a	5,03	5,17a	32,23	14,25a	13,28	23,04a	13,83
L.S.D at 5%	3,629		1,678		0,766		0,767		0,779	

Table (4): Effect of mineral-N and biofertilizers plus the supplements on flowering and bunch characteristics of Williams banana cultivar in newly reclaimed sandy soil (first season, 2002/2003)

Treatments	Shooting to harvest (days)	Earliness (days)	Bunch characteristics					
			Weight (kg)	% increase	No. of hands	% increase	No. of fingers	% increase
Nitrogen:								
N1 (200g)	156,38a		19,38c		8,75c		183,13c	
N2 (400g)	132,50b	23,88	22,50b	16,10	10,75b	22,86	201,25b	9,89
N3 (600g)	104,13c	52,25	26,88a	38,70	12,75a	45,70	224,00a	22,32
L.S.D at 5%	3,165		1,146		0,550		3,696	
Biofertilizer:								
Without Bio.	135,75a		21,92		10,08		196,75	
With Bio.	126,25b	9,5	23,92	9,12	11,41	12,12	208,83	6,14
L.S.D at 5%	2,585		0,935		0,449		3,018	

Table (5): Effect of mineral-N and biofertilizers plus the supplements on flowering and bunch characteristics of Williams banana cultivar in newly reclaimed sandy soil (second season, 2003/2004)

Treatments	Shooting to harvest (days)	Earliness (days)	Bunch characteristics					
			Weight (kg)	% increase	No. of hands	% increase	No. of fingers	% increase
Nitrogen:								
N1 (200g)	152,25a		20,63c		8,75c		180,38c	
N2 (400g)	128,63b	23,62	23,75b	15,12	11,00b	25,71	199,38b	10,53
N3 (600g)	100,63c	51,62	27,88a	35,14	13,25a	51,43	226,38a	25,50
L.S.D at 5%	3,165		1,291		0,734		3,804	
Biofertilizer:								
Without Bio.	133,33a		22,91b		10,41b		195,83b	
With Bio.	121,00b	12,33	25,25a	10,21	11,58a	11,24	208,25a	6,34
L.S.D at 5%	2,585		1,054		0,615		3,106	

4- Finger parameters:

Data presented in Tables (6&7) reveal that nitrogen application and biofertilizer positively increased the finger (weight, length and diameter) in both seasons. The above mentioned results were in harmony with those obtained by Jeeva *et al.* (1988) working on banana cv. Poovan, Tiwary *et al.* (1998) on banana cv. Giant Cavendish, Chezhiyan *et al.* (1999) on hill banana cv. Virupakshi, and Abd El-Naby (2000) on Maghrabi banana .

Table (6): Effect of mineral-N and biofertilizer plus supplements on finger parameters of Williams banana cultivar in newly reclaimed sandy soil (first season, 2002/2003)

Treatment	Finger weight	% increase	Finger length	% increase	Finger diameter	% increase
Nitrogen :						
N1 (200g)	68,5oc		15,83c		2,73c	
N2 (400g)	88,38b	29,02	20,54b	29,75	3,26b	19,41
N3 (600g)	106,50a	55,47	21,63a	36,64	4,14a	51,65
L.S.D. at 5%	3,541		0,345		0,151	
Biofertilizers:						
With bio.	84,17b		19,03b		3,16b	
With bio.	91,42a	8,61	19,63a	3,15	3,59a	13,61
L.S.D. at 5%	2,892		0,282		0,123	

Table (7): Effect of mineral-N and biofertilizer plus supplements on finger parameters of Williams banana cultivar in newly reclaimed soil (second season, 2003/2004)

Treatment	Finger weight	% increase	Finger length	% increase	Finger diameter	% increase
Nitrogen :						
N1 (200g)	70,00c		15,99c		2,69c	
N2 (400g)	91,25b	30,36	20,73b	29,64	3,35b	24,53
N3 (600g)	113,13a	61,61	21,83a	36,52	4,23a	57,25
L.S.D. at 5%	3,594		0,723		0,149	
Biofertilizers:						
With bio.	87,08b		19,16b		3,22b	
With bio.	95,83a	10,05	19,86a	3,65	3,63a	12,73
L.S.D. at 5%	2,935		0,591		0,122	

CONCLUSIONS

Generally, it could be concluded that the treatment of 600g ammonium nitrate and 5L HALEX /plant/year seems to be the promising treatment to produce the highest growth and yield characteristics under the above experimental conditions .

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تأثير التسميد الحيوي على نمو ومحصول نباتات الموز صنف وليامز في الأراضي الرملية بمنطقة النوبارية.

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أجريت هذه الدراسة في موسمين متتالين (٢٠٠٢/٣ ، ٢٠٠٣/٤) على نباتات الموز صنف وليامز نامية في أرض رملية تحت نظام الري بالتنقيط حيث أضيفت ثلاثة معدلات مختلفة من التسميد النيتروجيني وكانت المعدلات السنوية للنبات الواحد هي :

٢٠٠ ، ٤٠٠ ، ٦٠٠ جم نترات نشادر (٣٣,٥%) مع أو بدون السماد الحيوي هاليكس وقد وزعت كميات السماد النتروجيني المختبرة إلى ٨٤ جرعة في السنة (١٢جرعة كل شهر) أضيفت مع نظام الري بالتنقيط . وقد تم إضافة الهاليكس مرة واحدة في منتصف أبريل في صورة سائلة ٥ لتر / نبات .

وقد تم الحصول على أفضل نتائج للنمو الخضري والمحصول عند إضافة ٦٠٠ جم نترات نشادر مع ٥ لتر هاليكس لكل نبات في العام.