RESPONSE OF WILLIAMAS BANANA PLANTS TO APPLICATION OF EM AND YEAST

BADRAN, M.A.F. AND Y.A. MAHMOUD

Hort. Res. Instit., ARC, Giza

Abstract

This study was conducted at a privet orchared located in Al-wasta district, Assiut Governorate during 2005 / 2006 and 2006 / 2007 growing seasons to evaluate the effects of soil application of active dry yeast at (15 ,30 and 60 g /plant/ year) and EM, a commercial biostimulant at (150 ,300 and 600 ml /plant / year) as well as a combined of 60 g dry yeast and 600 ml of EM / plant /year on the height and girth of pseudostem, total leaf area of the plant , leaf N P K, bunch weight, weight of hand and finger, number of hands per bunch, pulp/peel as well as percentages of starch, total soluable solids,total and reducing sugars of Williams banana fruit .The soil applicaation was added at three equal doses (end of May ,June and July).

Results indicated that supplying Williams banana plant with active dry yeast and EM biostimulant either alone or in combination was responsible for enhancing growth aspects ,nutritional status of plants , yield as well as physical and chemical characters of the fruits compared to untreated plants .Using 60 gm /plant /year of active dry yeast considerably increased all the stuided prameters compared to the other dry yeast applications , also this increment was observed with using 600 ml EM biostimulant compared to the other EM treatments .

The best results with regard to pseudstem length and girth, leaf area, bunch and hand weights, number of hands per bunch fruit physical and chemical properties as well as leaf N , P and K % were detected due to using a mixture of 60 g /plant / year active dry yeast and 600 ml / plant / year EM biostimulant divided to equal three doses at the end of May ,June and July.

INTRODUCTION

Banana now is considerd one of the most important food crops allover the world especially in the tropics areas . The ripe banana pulp contains mainly carbohydrates and supplies a good amount of energy (100 cal/100 g). The banana is a fairly good source of vitamines A,B1,B2 and C and minerals such as Ca,K,P and Fe. Unripe fruits called plantains are cooked and provide a starch food with high nutritional value (Ahmed *et al.,* 1998).

Now, Egypt introduce a new banana cultivar namely Williams. Williams banana cv. has a medium pseudostem girth, greater number of ratoons, number of hands per bunch and number of fingers per hand. It is also has the largest bunches, hands and fingers and the highest annual yield. Ripe Williams banana is very sweet. It has an

early season of maturity and the shoortest vegatative cycle time. (Mostafa, 1988 and Robinson *et al.,* 1989).

Biofertilization for fruit crops became in the last few decades a positive alternative to chemical fertilizers. Biofertilizers are very safe for human, animals and environment and using them reduced the great pollution occurres in our environment. They are responsible for improving growth,uptake of nutrients, yield as well as physicaal and chemical properties of the fruits (Subba Rao,1984,Haggag *et al.*,1995,Ahmed *et al.*,1997, Akl *et al.*,1997,Ragab,1999,Ahmed *et al.,* 2003, Hammam, 2003 and El-Shenawi *et al.* 2008).

Safe cultivation can be greatly achived by using biofertilizers espeially yeast. Yeast contains cytokininis, IAA, proteins and amino acids.Also it contains fat,nucleic acid,enzymes and vitamins. It is very benificial and essential for the synthesis of aminoleulinic acid (AA) and is necessary for the formation of protaperphyrin, the precursor of chlorophyll (Hess,1981,Subba Rao,1984 and Abou-Zaid 1984).

For many years soil microbiologists and microbial ecologists have tended to differentiate soil microorganisms as beneficial or harmful according to their function and how they affect soil quality, plant growth , yield and plant health. A more specific classified of benificial microorganisms has been suggested by Higa (1991 and 1995) which he refers to an Effective Microorganisms or EM. If used properly, EM can significantly enhance the growth, yield and quality of crops (Higa and Wididana, 1991).Many authors documented favorable effeccts of using EM biostimulant on growth and yield of several crops such as mung bean Sangakkara, 1999 also Eissa 2003 on kelsey plum and Abd –El-Messeih *et al.* 2005 on Le Cont.

The merit of this study was to elucidate the beneficial effect of soil application of active dry yeast and EM biostimulant on growth and fruiting of Williams banana.

MATERIALS AND METHODS

The current study was imposed in a private orchared situated at Al-Wasta district, Assuit Governorate where the soil is clay during the two successive seasons of 2005/2006 and 2006/2007. Physical and chemical analysis of the tested soil according to Wild *et al.*, 1985 were shown in Table (1).

The experimental work started on the second and third ratoons of Williams

Character	Value
Particle size distribution:-	
Sand %	23.4
Silt %	18.7
Clay %	57.9
Texture	Clay
E.C. (m mhos/cm 25C)	0.85
$CaCo_3$	1.56
pH	8.66
Total nitrogen %	0.11
Avilable K (ppm,ammonium acetate)%	387.32
Avilable P (ppm,Olsen)	11.15

banana. The stools that are cultivated at 3.5*3.5 m were thinned to leave three ratoons for fruiting in the followwing seasons, in addition to the three plants that would give the crop of the current season.

The experiment involved the following eight treatments :

1- Control (untreated plants)

2- Soil application of 15 g active dry yeast /plant /year

3- Soil application of 30g active dry yeast /plant /year

4- Soil application of 60g active dry yeast /plant /year

5- Soil application of 150 ml EM biostimualant /plant /year

6- Soil application of 300 ml EM biostimualant /plant /year

7- Soil application of 600 ml EM biostimualant /plant /year

8- Combined soil application of 60 g active dry yeast +600ml EM /plant /year

The active dry yeast was prepared before soil application in solution form by mixing the amount of each treatment with sugar in 1 l of hot tap water (about 35 c) and kept at room temperature (25 c) for 12 hr befor applied , while the EM biostimulant applied to the soil in solution form which contain (EM + molases + well water). Irrigation the tested plants after soil application was done. The quantities of active dry yeast and EM solution were added at three equal doses at the end of May, June and July. The plants recived the soil N P K fertilization program that recommended by the Ministry Of Agriculture. Other agricultural practices were carried out as usual.

The exiperiment was set in a complet randomized block design with four replicates, each was represented with one Williams banana stool. Each stool contained three plants four fruiting in the current year plus three suckers for fruiting in the following one.

The following vegatative aspects were measured after the emergence of the inflorescence (mid week of August 2006 and 2007) .

1- Pseudostem height (m) and girth (cm)

2- Total leaf area according to Ahmed and Morsy (1999) using the formula La = 0.67(L+W) +107.15

At bunch shootimg stage ,leaf samples were taken from the third upper leaf in the succession of leaves from the top of the plant, as recomended by Simmonds (1966). Percentages of N,P and K were determined accordding to Wild *et al.,* 1985 on dry weight basis.

At the end of November 2006 and 2007, bunches were harvest when the fingers reached the full maturity stage. Befor achieving artificial ripening bunch weight (kg), nummber of hands per bunch were recorded. After the fingers were ripened, the following determinations were carried out :

1- Average hand weight (Kg)

2- Average finger weight (g)

3- Pulp / peel ratio

4- Total soluble solids % using hand refractometer.

5- Starch % (A. O. A. C, 1985)

6- Total and reducing sugars % (A. O. A. C, 1985)

Data were statistically analyzed using L.S.D. test to recognize the significance of the differences among various treatment means (Senedecor and Cochran 1972)

RESULTS AND DISCUSSION

1- Height and girth of pseudostem and total leaf area:

The results tabulated in Table (2) clearly show that, single soil application of 15, 30 and 60 g /plant /year yeast and 150 ,300 and 600 ml / plant / year EM biostimulant or combined application of 60g yeast +600 ml EM significantly improved the height, girth of pseudostem and the total leaf area compared with the control treatment. Soil application of active dry yeast in ascending order was very effective in promoting such characters.

Increasing yeast and EM leveles / plant / year followed by a gradual promotion on height and girth of pseudostem and leaf area. Combined application treatment of the two substnces was preferble than the single application of the substances in this respect. Similar results were recorded in both seasons of study.

The positive action of yeast on growth could be attributed to its content of cytokinins and vitamin B as well as its important role in building up of the carbohydrates. While the enhancement of plant growth by the EM biostimulant application may be attributed to the profound effect of plant growth regulating substances produced by the effective microorganisms or in improving the availability and acquisition of nutrients from the soil which promoted the vegatative growth Martin *et al.* (1989) and Jagnow *et al.,* (1991**)** indicated that the bacteria produced adequate amount of IAA and cytokinins, which increase the surface area per unit root length and hence enhanced the root hair branching with an eventual increase in acquisition of nutrients from the soil.

The present results are in agreement with those obtained by Ahmed *et al.,* 1995 and 2003 , Mahmoud 1996 and Abada 2002 on yeast and El-Gamal 1996 on EM.

2- Number of hands per bunnch :

The data in Table (2) indicated that all investigated treatments markedly increased number of hands per bunch compared with control except Single application of EM at application of 150 ml/ plant/ year treatment during the first season. Morever treatment of 60 gm / plant / year of active dry yeast gave the highest number of hands per bunch compared with the other yeast treatments, while soil application of 600 ml /plant /year of EM gave the highest number of hands / bunch compared with the other EM treatments. This results were true in both seasons. The previous results agreed with those obtained by Hammam (2003**),** Hammam *et al.* (2003) and El-Shenawi *et al.,* (2008).

Table 2. Effect of soil application of active dry yeast and EM biostimulant on height and girth of pseudostem, total leaf area and number of hands per bunch of Williamas banana in 2005/2006 and 2006/2007 seasons.

Treatment	Pseudostem height(m)		Pseudostem girth (cm)		Total leaf area (m2)		Num. of Hands / buncch	
	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007
Control (untreated)	1.98	2.15	72.00	74.30	26.70	29.93	11	10
Single application of yeast at 15g/plant/year	2.20	2.40	75.00	76.20	28.67	30.87	12	12
Single application of yeast at 30g/plant/year	2.33	2.46	77.00	79.30	30.22	34.27	13	12
Single application of yeast at 60g/plant/year	2.44	2.64	79.30	80.00	36.17	36.83	13.2	13
Single application of EM at150 ml/plant/year	2.12	2.17	76.20	77.10	28.67	30.57	11	11
Single application of EM at 300ml/plant/year	2.25	2.37	80.10	82.70	31.55	32.50	12	12
Single application of EM at 600 ml/plant/year	2.33	2.49	81.30	83.00	32.70	33.83	12.3	12.3
Combined application at 60 g yeast +600 ml EM/plant/year	2.60	2.68	83.10	86.00	36.77	37.57	13.2	13
L.S.D. aat 5 %	0.04	0.03	1.80	1.90	0.55	0.41	1.0	1.0

3 – Leaf mineral content (N , P and K) :

It can be stated from the data in Table (3) that single or combined soil application of active dry yeast and EM biostimulant were very effective in enhancing N , P and K percentages in the leaves over those of the control.

The effectiveness of these materials can be arranged in the descending order as follows, EM biostimulant then active dry yeast. The increase in N , P and K percentages was coincided with the increase in their leveles. Comined application of 60 g yeast and 600 ml EM treatment gave the highest values of N , P and K percentages and significantly increased compared with the control and the other yeast and EM treatments.These results were true in both seasons of study.

The promoting effectes of yeast and EM biostimulant on the nutritional statues of the leaves could be related to the role of the microorganisms in improving the avilabilty of nutrients and to the modifications of root growth, morphology and physiology, Jagnow *et al.,* 1991. Similar findings were reccorded by El-Gamal 1996, Mahmoud and Fatma 1999 and Abd-El-Messih *et al.* (2005) on EM as well as Ahmed *et al.* (1997a), Hegab *et al.* (1997), El-Mogy *et al.* (1998) and Ahmed *et al.*, (2003).

Table 3. Effect of soil application of active dry yeast and EM biostimulant on N , P and K percentages in the leaves of Williamas banana in 2005/2006 and 2006/2007 seasons.

Treatment	N %		P %		K %	
	2005/2006	2006/2007	2005/2006	2006/2007	2005/2006	2006/2007
Control (untreated)	1.32	1.46	0.133	0.177	2.04	2.09
Single application of yeast at 15g/plant/year	1.67	1.67	0.187	0.223	2.16	2.19
Single application of yeast at 30g/plant/year	1.72	1.71	0.230	0.257	2.23	2.26
Single application of yeast at 60g/plant/year	1.81	1.83	0.303	0.330	2.30	2.35
Single application of EM at150 ml/plant/year	1.73	1.74	0.240	0.243	2.23	2.28
Single application of EM at 300ml/plant/year	1.79	1.81	0.313	0.323	2.26	2.31
Single application of EM at 600 ml/plant/year	1.90	1.91	0.343	0.353	2.39	2.43
Combined application at 60 g yeast +600 ml EM/plant/year	1.92	1.93	0.407	0.423	2.46	2.49
L.S.D. at 5 %	0.08	0.02	0.03	0.01	0.04	0.02

4- Bunch , hand and finger weights :

Data in Table (4) show that single or combined application of active dry yeast and EM biostimulant significantly increased all of bunch, hand and finger weights of Williams banana compared with untreated plants (control). The effectiveness was enhanced with increasing dry yeast level from 15 to 30and 60g per plant per year and EM level from 150 to 300 and 600 ml / plant / year. The highest values of bunch weight as well as hand and finger weights were obtained due to combined soil applicaation of 60 g yeast and 600 ml EM compared with control and the other yeast and EM treatments, in addition this increment was significantly.

Under such promising treatment, bunch weight reached 28.33 and 29.50 kg in both seasons, also hand and finger weights reached 2.62 kg and 126.0 g in the first season while 2.66 kg and 125.50 g in the second season. The positive action of yeast and EM biostimulant on bunch, hand and fingrr weightes was ascribed to its important role in improving growth and nutritional status of the plants.

These results are in the same line of Ahmed-Kamilia *et al.* (2000) and Ahmed *et al.* (2003) on yeast and Sorial *et al.* (1998), Dawa *et al.* (2000) ,Eissa (2002 and 2003)and Abd-El-Messih *et al.,* 2005 on EM.

5- Pulp / peel (p / p) :

Data in Table (4) clearly show that p/p of Williams banana was positively affected by the yeast and EM biostimulant application treatments compared to control. Combined application of 60 g yeast and 600 ml EM gave the highest p/p and significantly increased compared with the control and the other yeast and EM treatments.

Application of 60 g yeast /plant / year gave the highest p/p compared with the other Single application of yeast treatments, while 600 ml EM / plant /year treatment gave the highest p/p compared with the other two EM treatments during the two investigated seasons.This results are in harmony with those obtained by El-Shamaa and Abd El-Hady (2001), Abada (2002), El-Sayed (2002) and Ahmed *et al.,*(2003).

Table 4. Effect of soil application of active dry yeast and EM biostimulant on bunch, hand and finger weights and pulp / peel of Williamas banana in 2005/2006 and 2006/2007 seasons.

Treatment	Bunch weight (kg)		Hand weight (kg)		Finger weight (g)		Pulp / Peel	
	2005/2006	2005/2006	2005/2006	2005/2006	2005/2006	2005/2006	2005/2006	2005/2006
Control (untreated)	21.33	21.95	1.93	1.96	98.77	102.00	1.21	1.29
Single application of yeast at 15g/plant/year	22.67	25.00	1.93	2.24	101.80	106.66	1.28	1.28
Single application of yeast at 30g/plant/year	26.17	26.77	2.13	2.48	113.00	118.30	1.41	1.42
Single application of yeast at 60g/plant/year	27.83	28.00	2.49	2.62	120.66	125.00	1.52	1.55
Single application of EM at150ml/plant/year	24.17	24.00	2.16	2.32	114.00	115.62	1.30	1.45
Single application of EM at 300ml /plant/year	25.17	25.65	2.26	2.45	115.32	122.00	1.35	1.50
Single application of EM at 600ml /plant/year	26.00	26.84	2.42	2.54	118.65	124.60	1.52	1.53
Combined application at 60g yeast+600ml EM/plant/year	28.33	29.50	2.62	2.66	126.00	125.50	1.55	1.56
L.S.D. at 5 %	0.82	0.53	0.07	0.03	1.32	0.85	0.03	0.02

6- Finger chemical characters :

The comparison among the EM and dry yeast treatments in hand and untreated (control) in the other hand for the chemical fruit quality of Williams banana trees are shown in Table (5) . Data clearly show that all the chemical properties of fruits were positively affected by the single or the combined soil application of yeast and EM compared with the control.

Fruit quality was greatly improved in termes of increasing total soluable solids, total as well as reducing sugars and decreasing starch due to the application of the two materials together in a combined treatment (60g yeast + 600 ml EM) than using each only. Supplying the plants with 15 g yeast treatment gave the lowest starch %. The highest TSS as well as total and reducing sugars obtained under supplying 60 g yeast treatment compared with the other dry yeast treatments. According to EM biostimulant treatments, supplying plants with 150 ml / plant / year gave the lowest starch % followed by 600 ml treatment then 300 ml /plant /year

treatment gave the highest starch %. Total as well as reducing sugars increas graduly with increasing the level of EM applications from 150 to 300 and 600 ml / plant /year, the differences between values were significantly. These results were true in both seasons.

The positive action of the active dry yeast and EM biostimulant on accelerating the biosynthesis of carbohydrates surely reflected on improving chemical quality of fruits. The resullts are in the same line of El-Shamaa and Abd El-Hady 2001, Abada 2002,El-Sayed 2002 :Ahmed *et al.*(2003) and El-Shenawi *et al.,* (2008) as well as Sorial *et al.* (1998), Dawa *et al* (2000) ,Eissa (2002 and 2003) and Abd-El-Messih *et al.*, (2005).

CONCLUSION

As a conclusion of this study, the combined treatment of soil application of 60 g dry yeast + 600 ml EM biostimulant per plant per year divided into three equal doses applyied at the end of May, June and July seems to be the promising treatment to produce the highest growth and obtained an economical yield and good fruit quality.

Table 5. Effect of soil application of active dry yeast and EM biostimulant on starch, total soluable solids as well as reducing and total sugars of Williamas banana in 2005/2006 and 2006/2007 seasons.

Treatment	Starch %		T S S %		Total Sugars %		Reducing sugars %	
	2005/2006	2006/2007	2005/2006	2006/207	2005/2006	2006/2007	2005/206	2006/2007
Control (untreated)	2.07	2.17	19.77	18.33	16.55	14.53	4.54	4.47
Single application of yeast at 15g/plant/year	1.37	1.30	20.03	20.62	18.00	18.60	6.10	6.49
Single application of yeast at 30g/plant/year	1.63	1.61	20.73	21.28	17.50	18.76	5.10	5.41
Single application of yeast at 60g/plant/year	1.84	1.71	20.77	20.99	18.80	18.90	7.14	6.72
Single application of EM at150 ml/plant/year	1.61	1.60	19.70	18.85	17.47	16.22	6.52	6.02
Single application of EM at 300ml/plant/year	1.78	1.71	21.03	19.72	18.90	16.71	6.80	6.12
Single application of EM at 600 ml/plant/year	1.67	1.64	21.50	21.62	19.60	19.62	7.07	6.77
Combined 60 g yeast +600 ml EM/plant/year	1.54	1.56	22.76	21.82	20.66	20.93	7.07	6.53
L.S.D. at 5 %	0.10	0.05	0.26	0.25	0.38	0.24	0.09	0.07

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استجابة نباتات الموز الوليامز لاستخدام ال E M والخميره

محمد أحمد فؤاد محمد بدران ، ياسر أنور محمود

معهد بحوث البساتين- مركز البحوث الزراعية - الجيزة

أجريت الدراسة خلال موسمين دراسيين ٢٠٠٦/٢٠٠٥ و ٢٠٠٧/٢٠٠٦ وذلك بمزرعة خاصة بمنطقة الوسطي بمحافظة أسيوط وذلك لدراسة تأثير ثلاث مستويات من الخميرة الجافة النشطة (١٥،٣٠،٦٠ جم / نبات / عام) وأيضاً ثلاث مستويات من المنشط الحيوي EM (١٥٠، ٣٠٠ ، ٦٠٠ مل / نبات / عام) الي جانب المعاملة المستخدم فيها ٦٠ جرام خميرة و٦٠٠ مل من EM / نبات / عام وذلك علي طول الساق وقطره والمساحة الكلية للاوراق ومحتوي الأوراق من النيتروجين والفوسفور والبوتاسيوم الي جانب وزن السباطة ووزن الكف والأصبع وعدد الكفوف فى السباطه ونسبة اللحم للقشرة الي جانب النسبة المئوية للنشاوالمواد الصلبة الذائبة والمحتوي من السكريات الكلية والذائبة .

أوضحت النتائج أن أضافة سواءا الخميرة أو ال EM كلاً علي حده او مجتمعين كان له الأثر المحسن علي النمو والمحتوي المعدنى والمحصول وايضا الصفات الطبيعية والكيميائية للثمار . بالنسبة لمعاملات الخميرة فقد أدت معاملة ٦٠ جرام خميرة / النبات / عام الي زيادة معنوية لكل الصفات المدروسة مقارنة بباقي معاملات الخميرة وكانت هذه الزيادة تحت أستخدام ٦٠٠ مل من EM / نبات / عام مقارنة بباقي معاملات ال EM .

أوضحت التجربة أن أعلي قيم لطول الساق ومساحة الورقة ووزن السباطة والكف والأصبع وعدد الكفوف فى السباطه وكذا الصفات الطبيعية والكيميائية بجانب المحتوي الورقى من النيتروجين والفوسفور والبوتاسيوم كان مع المعاملة التي أستخدم فيها ٦٠ جم خميرة مع ٦٠٠ مل من ال EM والتي اضيفت مقسمة علي ثلاث جرعات متساوية (نهاية مايو ويونية ويولية) وذلك مقارنة بباقي المعاملات البحثية .