Effect of Growth Promoting Bacterium on Growth, Yield and Fruit Quality of "Canino" Apricot

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ABSTRACT

Growth promoting bacteria (*Bacillus subtilis*) was sprayed on "Canino" apricot cultivar trees at two concentrations (0.2 and 0.4%) and at three stages (at full bloom, one month and two months after full bloom). The investigation was performed on trees of seven years old and grown in new reclaimed sandy soils, during the two successive seasons of 2006 and 2007. All treatments of *Bacillus* increased significantly shoot diameter and length, C/N ratio, total carbohydrates, N, P, and K contents, fruit yield, and fruit weight and volume as compared with the control (unsprayed trees) in the two seasons of the study. The highest fruit yield values in the two seasons were recorded by spraying *Bacillus* at 0.2% at two months after full bloom as compared with the lowest values of the control.

INTRODUCTION

Apricot (*Prunus armeniaca*) is deciduous fruit tree related to *Rosaceae* family and produce stone fruits (Drupe). Apricot fruits are delicious fruits used as fresh, dried and canned production. Apricot planted area in Egypt was 4785 Feddan in 1980 and reached 20971 Feddan in 2005 (Ministry of Agriculture Statistics). Apricot "Canino" cultivar is newly introduced cultivar gives high yield in new reclaimed lands. Rhizobacteria was named as plant growth promoting rizobacteria (PGPR) which could be useful for the plant through different mechanisms including: production of secondary metabolites such as antibiotics and hormone like substances, antagonism to soil borne root pathogens, phosphate dissolving and dinitrogen fixation (Alvarez *et al.*, 1995) working on tomato. *Bacillus cerus* exhibited beneficial effects on soybean nodulation and yield (Elizabith *et al.*, 2000). *Bacillus polymyxa* strains L6-16R, Pw-2R, and S20-R enhance conifer seedling growth (Shishido *et al.*, 1996). Varina (1999) had found that *Bacillus pumilus* using on muskmelon exhibited larger leaf area, greater dry mater accumulation. Tomato plant growth was enhanced by using combinations of humic and lactic acids and/or *Bacillus subtilis* (Böhme, 1999). Rodriguez and Draga (1999) stated that *Bacillus, Pseudomonas* and *Rizobium* are among the most powerful phosphate solubilizers and that increase phosphorus uptake. Also, in canola (*Brassica campestris*), soil incubation of three *Bacillus* strains increased root, shoot lengths, fresh and dry weight (Ghosh, *et al.*, 2003). Apricot trees spraying

by growth promoting bacterium (*Bacillus* OSU 142) gave higher yield than the unsprayed trees. Similarly, N, P, K, Ca and Mg contents of leaves were higher on treated trees than untreated control (Esitken *et al.*, 2004). In addition, combination of different strains of *Bacillus* increased root and shoot growth, enhanced stem diameter and rapid development of new roots of different vegetables (Kloepper, *et al.*, 2004). In addition, *Bacillus* sp. BB11 increased tomato yield (Guo *et al.*, 2004). Moreover, Wu *et al.* (2006) found that plant growth promoting bacteria stimulated plant growth of *Brassica juncea* and protected the plant from heavy metal toxicity.

The aim of the present investigation is to study the effect of spraying apricot trees by Bacillus *subtilis* on tree growth, fruit yield and quality.

MATERIALS AND METHODS

The present work was conducted during the two growing successive seasons of 2006 and 2007 on "Canino" apricot cultivar trees grown in new reclaimed sandy soil in private orchard at Kafer Dawood, Sadat city, in El-Menofia governorate. Trees were seven years old, almost uniform in vigor, grafted on Balady apricot seedlings and planted at 5 X 5 meter apart. For this study 21 trees were chosen for 7 treatments, each treatment was applied on three replicates (one tree for each replicate) according to the randomized complete block design. The applied treatments were as follows:

1) Control (sprayed with tap water)
2) 0.2% Bacillus at full bloom (F.B).
3) 0.2% Bacillus at 1 month after F.B.
4) 0.2% Bacillus at 2 month after F.B.
5) 0.4% Bacillus at F.B.
6) 0.4% Bacillus at 1 month after F.B.
7) 0.4% Bacillus at 2 month after F.B.

All trees were sprayed until run off (10 L/tree). During the two seasons, five branches representing all tree sides were chosen at random and labeled before spraying and the number of flowers per each one was counted. The number of retained fruits per each branch was recorded and the retained (remained) fruits percentages were calculated before picking. At picking, samples of twenty fruits from each replicate were taken to determine the following characteristics:

1. Yield (Kg/tree): It was determined by multiply number of fruits/tree X the average of fruit weight.
2. Average fruit weight (gm).
3. Average fruit volume (ml).

4. Average fruit diameter (cm).
5. Average fruit length (cm).
6. Average fruit firmness (lb/Inch^2) was estimated by Magnese-Taylor pressure tester.
7. Total soluble solids of fruit juice were estimated by using hand refractometer.
8. Total acidity (%) was calculated as gm malic acid/100 g fresh weight (A.O.C.A., 1995).

After picking average increments of shoot diameter and length were calculated. Also, the leaf area of about 20 leaves for each replicate was measured using a planimeter according to Nautigual *et al.* (1990) and leaf chlorophyll was determined according to Yadava (1986).

Samples of twenty leaves from the middle part of shoots according to Chuntanaparb and Cummings (1981) were selected at random from each replicate to determine their content of N, P, K and Mg according to Evenhuis (1978). Fe, Zn and Mn were also determined using Atomic absorption Perkin Elmer. Determinations of the leaf contents of nutrients were carried out on a dry weight basis.

STATISTICAL ANALYSIS:

The collected data were subjected to the proper statistical analysis of complete randomized block design according to Snedecor and Chochran (1990).

RESULTS AND DISCUSSION

VEGETATIVE GROWTH:

Results in Table (1) show the effect of spraying growth promoting bacterium (*Bacillus subtilis*) at different concentrations and stages on vegetative growth (shoot diameter and length increment (cm) and leaf area (cm^2). All treatments increased significantly shoot diameter as compared to the control in the two studied seasons except the treatment of 0.4% Bacillus at 2 months after full bloom (F.B.). The highest increments in shoot diameter (0.150 and 0.150 cm) were obtained by the treatment of 0.2% Bacillus sprayed at full bloom, as compared with the lowest values of control treatment (0.041 and 0.044 cm), in 1st and 2nd seasons, respectively. Shoot length was increased by all treatments of spraying Bacillus in the two studied seasons. The highest increments in shoot length (11.33 and 11.92 cm) resulted from the spraying of Bacillus at 0.4% at 1 month after F. B. as compared with the lowest values of the control (3.33 and 4.75 cm) in the first and second seasons, respectively. These results

are in harmony with those of Esitken *et al.* (2004) on apricot; Kloepper *et al.* (2004) on different vegetables and Wu *et al.* (2006) on *Brassica juncea*, who emphasized that spraying Bacillus increased plant growth.

LEAF AREA, CHLOROPHYLL AND C/N RATIO:

Leaf area, chlorophyll contents and C/N ratio as affected by Bacillus spraying are shown in Table (1). All treatments increased significantly leaf area (cm^2) as compared to the control in the two studied seasons, except the treatments of Bacillus at 0.2% at one and two months after F.B. in both seasons and of 0.4% at one month after F.B. in the first season only. The highest leaf area values (48.01 and 49.1 cm^2) were obtained by the treatment of 0.4% at F.B. as compared with the control (38.08 and 38.8 cm^2) in the first and second seasons, respectively. As for C/N ratio, all the treatments of spraying Bacillus increased C/N ratio as compared to the control in the two seasons of the study. The highest C/N ratios (4.51 and 4.52) were obtained by spraying Bacillus at 0.4% at F.B. as compared by the lowest values (3.52 and 3.39) in the first and second seasons, respectively. The other treatments recorded in between values. As for leaf chlorophyll, data showed that all treatments of Bacillus without clear trend.

LEAF TOTAL CARBOHYDRATES:

Results in Table (2) show the effect of spraying growth promoting bacterium (*Bacillus subtiilis*) at different concentrations and times on Leaf total carbohydrates (%). All treatments increased significantly leaf total carbohydrates (%) in the two seasons of the study as compared with the control. The highest contents of total carbohydrates (9.63 and 9.60%) were obtained by spraying Bacillus at 0.4% at one month after full bloom (F.B.) as compared with the lowest values of the control (6.20 and 6.10%) in the first and second seasons, respectively.

LEAF MACRO AND MICRO ELEMENTS:

Leaf elements contents (N, P, K and Mg) as affected by spraying growth promoting bacterium (*Bacillus subtiilis*) at different concentrations and stages are shown in Table (2). All treatments increased nitrogen (N), phosphorus and potassium (K) in both seasons of the study as compared to the control. The highest significant N contents (2.39 and 2.45%) were recorded by spraying *Bacillus* at 0.4% at one month after F.B. as compared with the control lowest contents (1.76 and 1.80%) in the first and second seasons, respectively. The highest P contents (0.97 and 0.96%) were recorded as a result of spraying Bacillus at 0.2% at 2 months after F.B. as

compared with the control (0.61 and 0.62%) in the 1st and 2nd seasons, respectively. The highest K contents (2.15 and 2.18%) were recorded as a result of spraying *Bacillus* at 0.4% at F.B. as compared with the control (1.78 and 1.8%) in the 1st and 2nd seasons, respectively. As for Mg%, only three treatments of *Bacillus* at 0.2% at one month after F.B.; 0.4% at F.B. and at 0.4% at one month after F. B. was significantly effective on Mg% contents where they increased Mg contents as compared with the control in the two seasons of study. As shown in Table (3), all the treatments did not increase significantly Fe contents in the two seasons of the study except the treatments of *Bacillus* at 0.2% and 0.4% at one month after F.B. and which increased significantly Fe contents. The treatments of *Bacillus* at 0.4% at 2 months after F.B. in the two seasons of the study and at 0.2% at 2 months in the first season only increased significantly Zn contents as compared to the control. The other treatments were not effective. As regard to Mn contents, the treatment of 0.4% Bacillus at one month only increased the Mn content in the two seasons as compared with the control.

These results are in agree with those obtained by Esitken *et al.* (2004) on apricot who found that N, P, K, Ca and Mg contents of leaves were higher on treated trees by Bacillus than untreated control.

RETAINED FRUIT (%):

Results in Fig. (1) show the effect of spraying growth promoting bacterium (*Bacillus subtillis*) at different concentrations and stages on retained fruit percentages in 2006 and 2007 seasons. The treatments of spraying *Bacillus* at 0.2% at 2 months after F.B., at 0.4 at F.B., at one and two months increased significantly the retained fruits (%) as compared with the control in the two seasons of the study, but the remained treatments were not effective. The highest percentages (6.70 and 13.57%) obtained by the treatment of spraying *Bacillus* at 40.4% sprayed at F.B. as compared with the lowest percentages (1.66 and 3.43%) in the first and second seasons, respectively. The other treatments recorded in between values.

YIELD (Kg/TREE):

Fig. (2) show the effect of spraying growth promoting bacterium (*Bacillus subtiilis*) at different concentrations and times on fruit yield (Kg/tree) in the seasons of 2006 and 2007. All treatments of spraying *Bacillus* increased fruit yield in the two seasons of the study as compared with the control except the treatment of at 0.2% at full bloom that was ineffective in the two seasons. The highest significant yield values (58.33 and 61.67 Kg /tree) were obtained by *Bacillus* spraying at 0.2% at two

months after F.B. as compared with the lowest yield values (41.67 and 46.00 Kg/tree) in the first and second seasons, respectively. The other treatment recorded in between values.

The obtained results are in line with those of Esitken *et al.* (2004) on apricot who found that yield/tree was higher on treated trees by Bacillus than untreated control ones.

PHYSICAL FRUIT CHARACTERISTICS:

Results in Table (4) show the effect of spraying growth promoting bacterium (*Bacillus subtiilis*) at different concentrations and stages on physical fruit characteristics in the two seasons of 2006 and 2007. All treatments increased significantly fruit weight and volume in the two seasons of the study as compared with the control. All treatments increased significantly fruit length and diameter and flesh thickness in the second season only as compared with the control. As for flesh thickness, data revealed that the application of 0.2% Bacillus at two months after F.B. only increased the flesh thickness as compared with other treatments. As regard seed weight the treatments of *Bacillus* at 0.2% sprayed at different stages and at 0.4% at full bloom and at one month after F.B. increased significantly seed weight in the second season only as compared with the control. As for fruit firmness, the treatments of 0.2% at different stages and at 0.4% at full bloom gave emphasized values higher than the control in the two seasons as compared with the control.

The obtained results are in harmony with those of Esitken *et al.* (2004) on apricot who found that fruit weight was higher on treated trees by Bacillus than untreated control ones.

CHEMICAL FRUIT CHARACTERISTICS:

Chemical fruit characteristics (T.S.S., acidity and TSS/acid ratio) as affected by spraying growth promoting bacterium (*Bacillus subtiilis*) at different concentrations and stages on in the two seasons of 2006 and 2007 are shown in Table (5). The treatments of *Bacillus* at 0.2% at one and two months after F.B. and at 0.4% at full bloom and at one month after F.B. in the second season only increased T.S.S. as compared with the control. Generally all treatments were not effective on acidity values except the treatment of 0.2% at one month after full bloom in the two seasons of the study as compared with the control. The treatments of 0.2% at 2 months after F.B. in the second season only, and 0.4% at full bloom, 0.4% at one month and at two months after F.B. in the two seasons of the study increased T.S.S./acid ratio as compared with the control and that mean that fruits produced from that treatments were sweeter than the fruits produced from the control.

Table (1) Effect of growth promoting bacterium on vegetative growth; leaf Chlorophyll and C/N ratio of "Canino" apricot trees during 2006 and 2007 seasons.

Treatments	Shoot diameter increment (cm)		Shoot length increment (cm)		Leaf area (cm^2)		Leaf chlorophyll (SPDA)		C/N ratio	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Control	0.041	0.044	3.33	4.75	38.08	38.8	37.27	40.67	3.62	3.39
0.2% Bacillus at F.B	0.150	0.150	7.25	7.69	45.83	47.18	40.95	41.92	3.89	3.90
0.2% Bacillus at 1 month after F.B	0.092	0.092	4.42	5.17	40.51	43.28	34.37	39.37	3.85	3.90
0.2% Bacillus at 2 month after F.B	0.100	0.110	6.033	6.277	39.16	45.44	36.13	42.17	3.87	3.66
0.4% Bacillus at F.B	0.050	0.05	8.97	8.92	48.01	49.41	38.30	41.53	4.51	4.52
0.4% Bacillus at 1 month after F.B	0.120	0.117	11.33	11.92	40.61	47.12	38.67	41.03	4.03	3.92
0.4% Bacillus at 2 month after F.B	0.100	0.119	10.32	10.92	44.69	44.94	37.53	39.94	3.86	3.83
L.S.D. at 5%	0.029	0.034	0.437	0.887	3.210	1.030	1.130	N.S.	0.094	0.106

F.B. = Full bloom

Table (2): Effect of growth promoting bacterium on total carbohydrates and leaf macro elements (%) of "Canino" apricot trees during 2006 and 2007 seasons.

Treatments	Total carbohydrates (%)		N (%)		P (%)		K (%)		Mg (%)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Control	6.20	6.10	1.76	1.80	0.61	0.62	1.78	1.80	0.31	0.32
0.2% Bacillus at F.B	7.70	7.80	1.98	2.00	0.78	0.80	1.90	1.96	0.28	0.23
0.2% Bacillus at 1 month after F.B	8.59	8.90	2.31	2.35	0.82	0.84	1.99	1.96	0.32	0.33
0.2% Bacillus at 2 month after F.B	8.25	8.30	2.25	2.27	0.97	0.96	2.01	2.03	0.30	0.30
0.4% Bacillus at F.B	9.51	9.50	2.11	2.10	0.77	0.79	2.15	2.175	0.32	0.32
0.4% Bacillus at 1 month after F.B	9.63	9.60	2.39	2.45	0.87	0.88	2.08	2.10	0.33	0.33
0.4% Bacillus at 2 month after F.B	8.79	8.80	2.28	2.30	0.98	1.01	2.08	2.10	0.31	0.31
L.S.D. at 5%	0.114	0.205	0.053	0.046	0.015	0.0026	0.034	0.021	0.005	0.005

F.B. = Full bloom

Table (3): Effect of growth promoting bacterium on leaf micro elements (ppm) of "Canino" apricot trees during 2006 and 2007 seasons.

Treatments	Fe (ppm)		Zn (ppm)		Mn (ppm)	
	2006	2007	2006	2007	2006	2007
Control	74	73	32	30	57	58
0.2% Bacillus at F.B	70	71	23	21	52	53
0.2% Bacillus at 1 month after F.B	77	78	20	19	58	60
0.2% Bacillus at 2 month after F.B	73	73	26	27	57	56
0.4% Bacillus at F.B	74	75	19	20	58	59
0.4% Bacillus at 1 month after F.B	78	77	23	22	60	61
0.4% Bacillus at 2 month after F.B	72	71	41	40	57	58
L.S.D. at 5%	1.345	1.736	1.435	1.098	1.895	1.601

F.B. = Full bloom

Table (4): Effect of growth promoting bacterium on fruit physical characteristics of "Canino" apricot trees during 2006 and 2007 seasons.

Treatments	Fruit weight (gm)		Fruit volume (ml)		Fruit length (cm)		Fruit diameter (cm)		Flesh thickness (cm)		Seed weight (gm)		Firmness (lb/inch²)	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Control	24.6	29.9	23.1	28.4	4.1	4.2	4.5	4.5	1.23	0.95	2.20	2.17	9.7	13.9
0.2% Bacillus at F.B	31.1	47.7	28.7	40.6	4.6	4.6	4.6	4.6	1.30	1.28	2.50	2.46	16.7	20.7
0.2% Bacillus at 1 month after F.B	32.2	36.8	30.3	36.0	4.1	4.1	4.2	4.2	1.29	1.10	2.10	2.40	13.3	14.3
0.2% Bacillus at 2 month after F.B	32.5	41.6	30.6	38.9	4.2	4.3	4.2	4.2	1.27	1.27	2.20	2.61	18.3	21.3
0.4% Bacillus at F.B	32.1	48.4	30.7	46.6	4.8	4.6	4.3	4.5	1.20	1.17	2.17	2.50	13.5	16.7
0.4% Bacillus at 1 month after F.B	34.8	40.0	33.4	38.4	4.1	4.1	4.1	4.1	1.33	1.17	2.23	2.61	10.7	12.7
0.4% Bacillus at 2 month after F.B	33.0	38.3	32.0	36.3	4.0	4.0	3.9	4.0	1.20	1.29	2.20	2.13	11.3	13.7
L.S.D. at 5%	0.652	1.156	0.699	0.848	0.063	0.077	0.056	0.087	0.041	0.067	0.022	0.102	0.911	0.728

F.B. = Full bloom

Table (5): Effect of growth promoting bacterium on fruit chemical characteristics of "Canino" apricot trees during 2006 and 2007 seasons.

Treatments	T.S.S. (%)		Acidity (%)		T.S.S./acid Ratio	
	2006	2007	2006	2007	2006	2007
Control	14.77	14.11	0.85	0.91	17.38	15.67
0.2% Bacillus at F.B	14.40	14.17	0.91	0.95	15.82	14.92
0.2% Bacillus at 1 month after F.B	14.73	14.83	1.08	1.11	13.64	13.36
0.2% Bacillus at 2 month after F.B	14.80	15.67	0.81	0.85	18.02	18.44
0.4% Bacillus at F.B	14.80	17.17	0.72	0.79	20.55	21.73
0.4% Bacillus at 1 month after F.B	14.73	15.33	0.66	0.76	22.32	20.17
0.4% Bacillus at 2 month after F.B	14.60	13.67	0.53	0.59	27.55	23.17
L.S.D. at 5%	0.169	0.429	0.048	0.081	1.364	1.365

F.B. = Full bloom

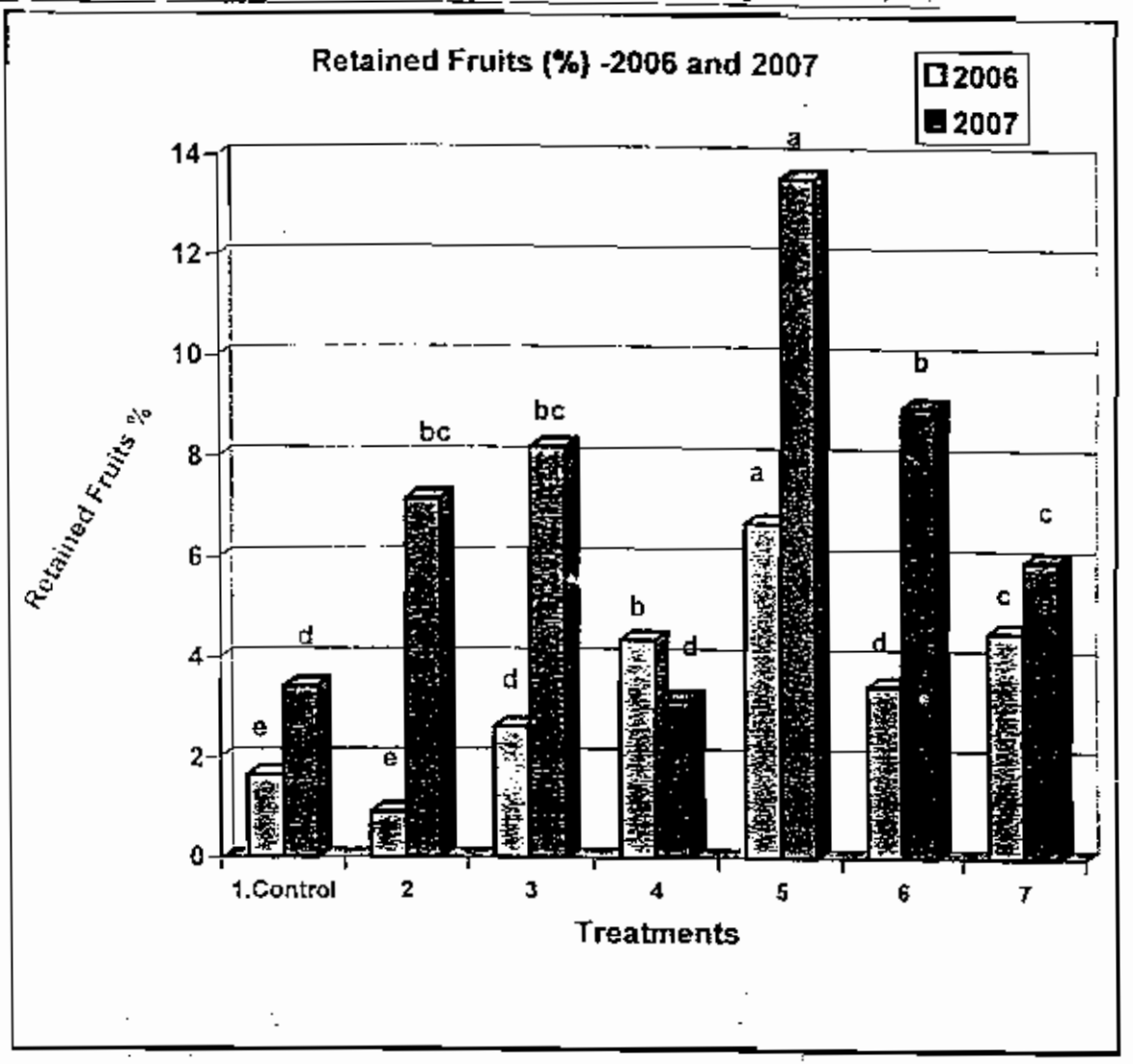

Fig. (1): Effect of growth promoting bacterium on Retained fruits (%) of "Canino" apricot trees during 2006 and 2007 seasons. Values obtained the same letter within similar columns for each seasons are not significant different.

2) = 0.2% Bacillus at F.B.

3) = 0.2% Bacillus at 1 month after F.B.

4) = 0.2% Bacillus at 2 month after F.B.

5) = 0.4% Bacillus at F.B.

6) = 0.4% Bacillus at 1 month after F.B.

7) = 0.4% Bacillus at 2 month after F.B.

F.B. = Full bloom

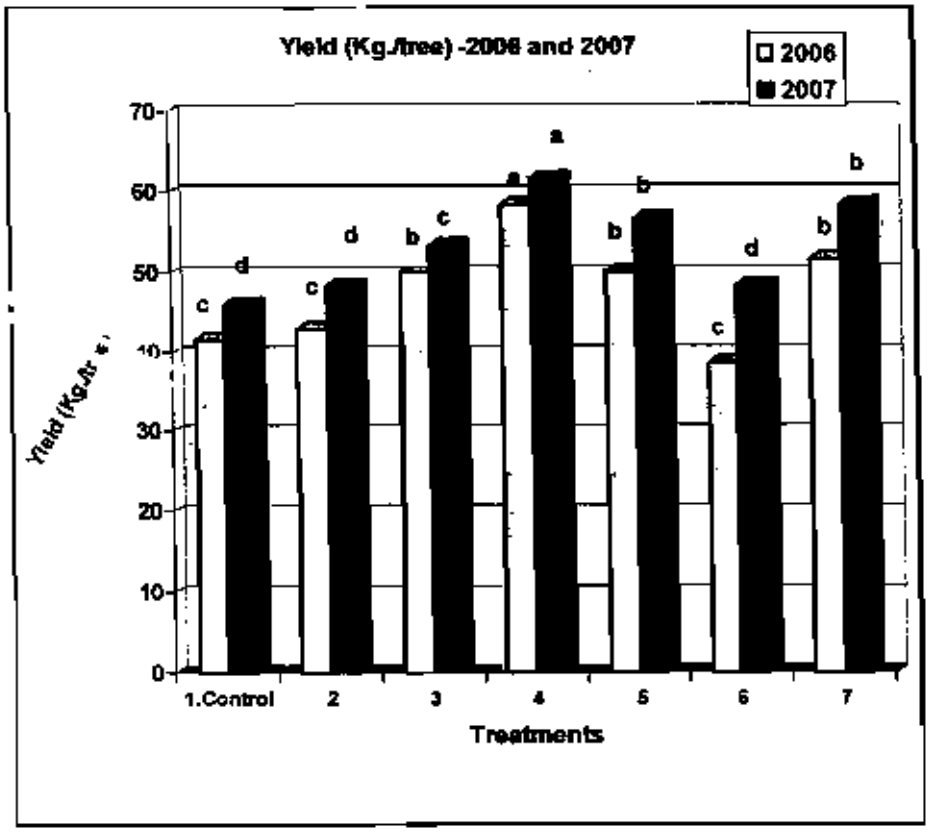

Fig. (2): Effect of growth promoting bacterium on yield (Kg/tree) of "Canino" apricot trees during 2006 and 2007 seasons. Values obtained the same letter within similar columns for each seasons are not significant different.

2) = 0.2% Bacillus at F.B

3) = 0.2% Bacillus at 1 month after F.B.

4) = 0.2% Bacillus at 2 month after F.B.

5) = 0.4% Bacillus at F.B.

6) = 0.4% Bacillus at 1 month after F.B.

7) = 0.4% Bacillus at 2 month after F.B. F.B. = Full bloom

REFERENCES

Alvarez, M B.; S. Gagne and H. Antoun (1995). Effect of compost on rihizosphere microflora of the tomato and on the incidence of plant growth promoting rhizobacteria. Appl. Nd Environ. Microbial, 61: 194-199.

A. O. A. C. (1995). Official Methods of Analysis. Published by the A.O.A.C. Box 540, Washington.

Böhme, M. (1999). Effect of lactate, humate and Bacillus subtilis on the growth of tomato plants in hydroponic systems. International Symposium on growing media and Hydroponics (abstract).

Chuntanaparb, N. and G. Cumming (1981). Seasonal trends in concentration of nitrogen, phosphorus, potassium, calcium and magnesium in leaf portions of apple, blueberry, grape and peach. J. Amer. Soc. Hort. Sci., 105 (6); 933.

Elizabeth, R. K.; R. M. Goadman; C. R. Crau; D. W. Johanson; E.V. Nordheim; D. J. Undersonder and J. Handlesman (2000). Regression analysis for evalutation the influence of Bacillus cerus on alfalfa yield under variable disease intensity. Amer. Phytopathology Soc., 90: 657 – 665.

Esitken, A.; H. Karlidag; S. Ercisli; M. Turan and F. Sahin (2004). The effect of spraying a growth promoting bacterium on the yield, growth and nutrient element composition of leaves of apricot (*Prunus armeniaca* L. cv. Hacihaliloglu). Australian J. of Agric. Res., Vol. 54 No. 4: 377-380.

Evenhuis, B. (1978). "SimplifieMethods for Foliar Analysis". Koninklijk nstitutt Voor de Tropen, Amsterdam, P.P. 1-170.

Ghosh, S.; J.N. Penterman; R.D. Little; R. Chavez and B. R. Glick (2003). Three newly isolated plant growth promoting bacilli facilitate the seedling growth of canola, *Brasica campestris*. Plant Physiol. And Biochemistry Vol. 4 No. 3: 277-281.

Guo, G.; H. Qi; Y. Guo; H. Ge; L. Gong; L. Zhang and P. Sun (2004). Biocontrol of tomato wilt by plant growth promoting rhizobacteria. Biological Control,Vol. 29 N0.1: 66-72.

Kloepper, M.S.; M.S. Reddy; R. Rodriguez-Kabana; D.S. Kenney; N. Kokalis-Burelle and N. Martinez-Ochoa (2004). Application for rhizobacteria in transplant production and yield enhancement. ISHS Acta Hort. 631. XXVI International Hort. Congress: Issues and advances in transplant production and stand establishment research (Abstract).

Nautigual, M. C.; P. K. Singh; R. N. Shuklia; S. Prakash and kummar (1990). Correcting leaf area measurement by conventional methods. A new approach of apple (*Malus domestica* Borkh). J. Hort. Sci., 65: 15-18.

Rodriguez, H. and R. Draga (1999). Phosphate solubilizing bacteria and their role in plant growth promotion. Biotechnology advances Vol.17, No. 4-5 : 319-339.

Shishido, M.; H. B. Massicotte and C. P. Chanway (1996). Effect of plant growth promoting *Bacillus* strains on pine and spruce seedling growth and mycorhizal infection. Annals of Botany, Volume 77, No. 5 : 433-442.

Snedecor, G. w. and G. W. Cochran (1990). Statistical methods. 7th Ed. Thelowa State Univ., Iowa, USA.

Varina, C.S. (1999). The effect of LS 213 (*Bacillus pumillus*) on plant growth promotion and systemic resistance in muskmelon and water melon transplants and subsequent field performance.

Wu, S., C.; K.C. Cheung; Y.M. Luo and M. H. Wong (2006). Effects of inoculation of plant growth promoting rhizobacteria on metal uptake by *Brassica juncea*. Environmental Pollution, Vol. 140 (1): 124-135.

Yadava, Y. L. (1986). Rapid and non-destructive methods to determine chlorophyll in intact leaves. HortScience, 21 1449 – 1450.

الملخص العربي

تأثير البكتريا المنشطة للنمو على نمو ومحصول وجودة ثمار المشمش صنف 'كاتينو'

هناء محمود شريف – نجوى أبوالمجد عبد المجيد – عبدالفتاح سليمان والى

معهد بحوث البســـاتين – مركز البحوث الزراعية – جيزة

رشت البكتريا المشجعة للنمو من الجنس باسيلس (*Bacillus*) على أشجار المشـــمش صنف 'كاتينو' بتركيزين (٠,٢% و ٠,٤%) و ثلاثة مواعيد (عند الإزهار الكامل و بعد الإزهـــار بشهر و شهرين). وقد تم إجراء البحث على أشجار عمر ٧ ســـنوات منزرعة في أراضي رملية مستصلحة في موسمين متتاليين ٢٠٠٦ و ٢٠٠٧. وقد أدت كل معاملات بكتريا الباســيلس إلـــى زيادة معنوية في كل من قطر وطول الفرع و نسبة الكربوهيدرات إلى النيتروجين و الكربوهيدرات الكلية و النيتروجين والفوسفور والبوتاسيوم والمحصول ووزن وحجم الثمرة عند مقارنتها بالأشجار المقارنة (الكنترول) في موسمي الدراسة. وقد نتج أعلى محصول في موسمي الدراسة عنـــد رش البكتريا من جنس باسيلس بتركيز ٠,٢% بعد شهرين من الإزهار الكامل عند مقارنتها بالأشـــجار غير المرشوشة (الكنترول).